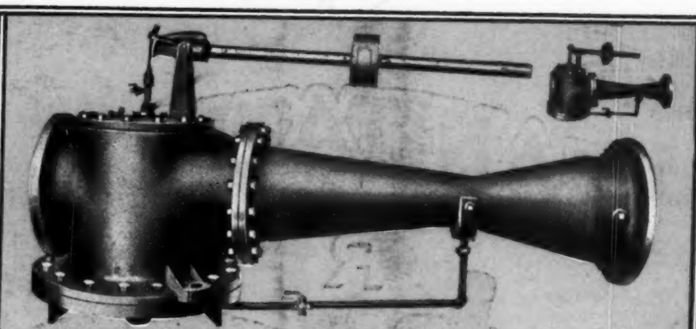
PUBLIC WORKS

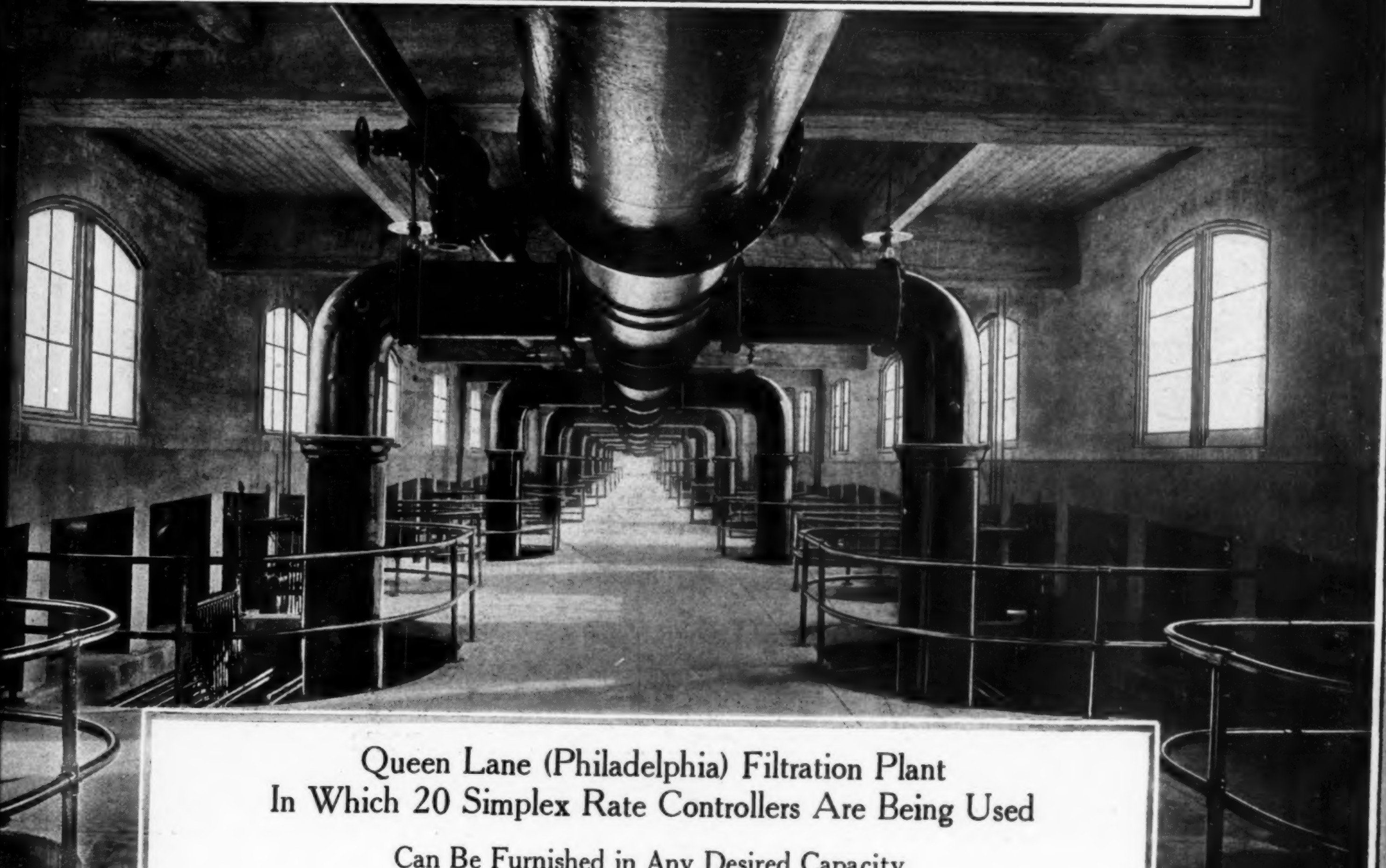
CITY COUNTY STATE

Prevent
Oscillations and Breaking
Filter Beds
Reliable and Simple
in Operation



Large Numbers
Have Been in Continuous Operation
for Many Years

Simplex Filter Rate Controllers



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In Which 20 Simplex Rate Controllers Are Being Used

Can Be Furnished in Any Desired Capacity

SIMPLEX VALVE & METER COMPANY

5722 Race Street Philadelphia, Pa.

MAY 13, 1922

VOL. 52 NO. 19

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PUBLIC WORKS.

CITY . COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 May 13, 1922 No. 19

Birmingham's Water Works System

By N. M. Berberich* and W. A. Hardenbergh†

Water company mines its own coal—Maximum use of labor-saving appliances—Is increasing its pumping capacity forty per cent., adding eight filter units and extending its distribution system—Eighteen hundred consumers own nearly a million dollars of stock in the company.

Birmingham and its environs have grown so rapidly in population during the past twenty years that the problem of furnishing an adequate water supply has been a large one. In 1900 there were 4,500 consumers; in 1921, there were about 29,500, an increase of 600 per cent. The consumption of water is now in the neighborhood of twenty million gallons daily.

A complete program of improvements inaugurated

*Chemist, Birmingham Water Works Company.
†Health Officer, Jefferson County, Alabama.

GENERAL VIEW OF CAHABA RIVER PUMPING STATION, BIRMINGHAM

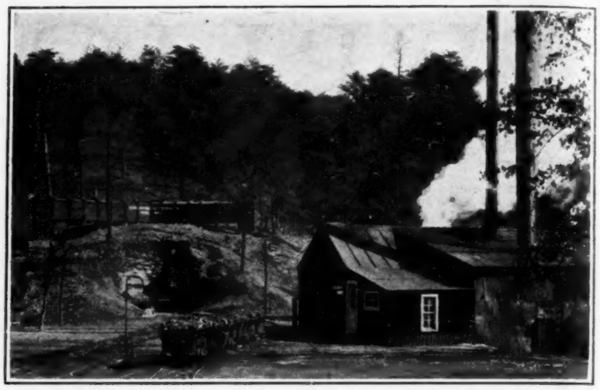
last year and now being carried forward to completion is the visible evidence of the policy of the Birmingham Water Works Company to keep its resources, supplies, and equipment ahead of the needs of the community. The program includes an increase of 40 per cent. in the pumping station capacity, already completed; the construction of eight new concrete filters, now under way; the construction of many thousand feet of additional water mains and lines; and the extension of the distribution system to two more of Birmingham's suburbs, Boyles and Tarrant City. During the past year, 1,918 meters were installed, which is about the annual average.

Water for the city is secured from two sources. Originally the supply came from Five Mile creek, which is located north of the city. In 1888, foreseeing the demand for a much greater quantity of water than could be secured from this source, the company developed a new supply at the Cahaba river, some ten miles southeast of the city. Today, Five Mille creek furnishes less than one-quarter of the city's water, as the amount available from this source totals only about five million gallons daily.

Five Mile Creek has a watershed area of 16 square miles above the waterworks' intake. The population density is 31.8 persons per square mile. There are no villages on the watershed, most of the inhabitants being farmers or dairymen. There appears to be no direct sewage pollution of this water, which is regularly of good quality for a surface supply.

CAHABA RIVER SUPPLY

The Cahaba supply includes the Cahaba river and the Little Cahaba. The watershed of the former covers about 170 square miles, and of the latter about 30 square miles. Both of these streams are situated in a mountainous section of the county, sparsely settled. The population on the watersheds average about 20 persons per square mile. The

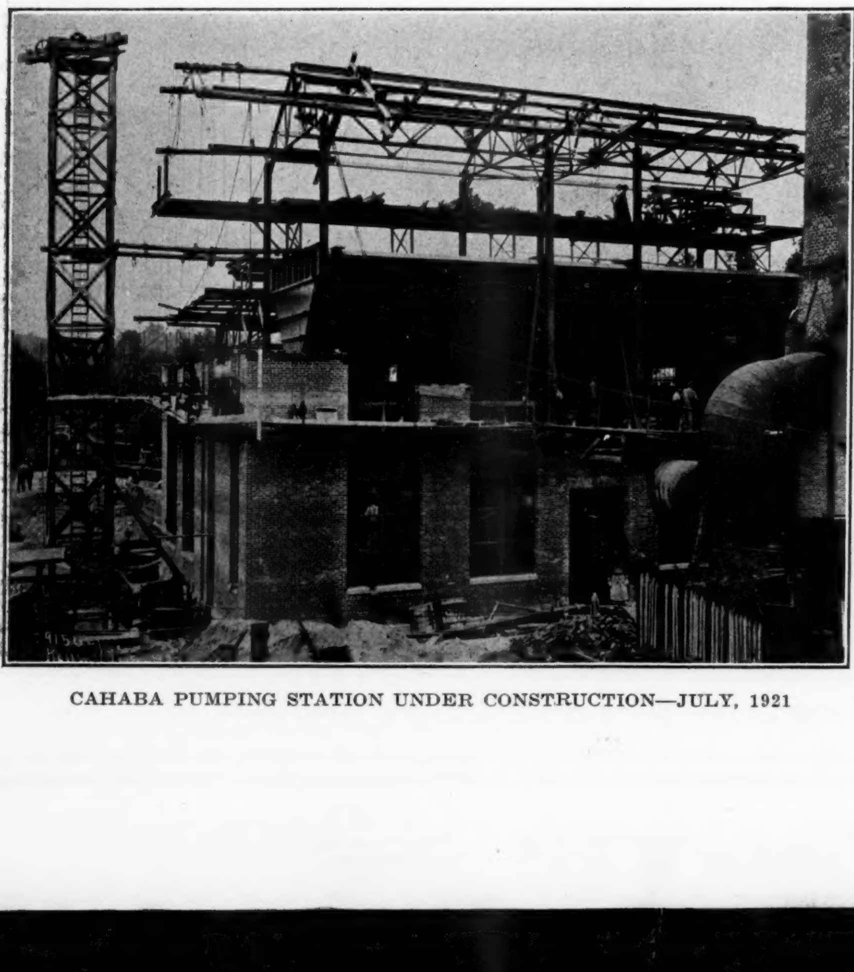


ENTRY TO WATER COMPANY'S MINE

company owns about 4,000 acres of land along these streams.

At present as much water as is needed is taken from the Cahaba river, the flow of which, even in dry weather, has been sufficient to supply the needs of the city. To provide for the future, however, an impounding reservoir, Lake Purdy, has been constructed on the Little Cahaba, where is held sufficient water to supply the city for three months. The dam at Lake Purdy is of masonry, 40 feet high and 250 feet long, forming a lake of 350 acres with a capacity of more than a billion and a half gallons of water. The dam is so constructed as to allow it to be raised an additional 20 feet, which would increase the storage capacity of the lake to about 5,700,000,000 gallons.

When water from Lake Purdy is needed, it will be discharged from the reservoir and will flow down the Little Cahaba to the junction of that stream with the main river. Here a small diverting dam is so placed that the current in the larger river is reversed, and the water flows upstream in the Big Cahaba to the pumping station.



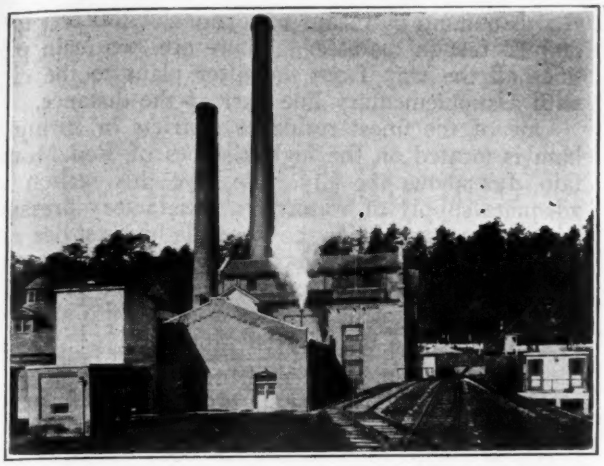
CAHABA PUMPING STATION UNDER CONSTRUCTION—JULY, 1921

The water taken from the Cahaba is pumped over the mountains to the filter plant on top of Shade's Mountain, six miles east of the city. In pumping from the Cahaba supply to the filter plant, the pumps work against a head of 458 feet.

CAHABA PUMPING STATION

The equipment at the Cahaba pumping station is modern and complete. An interesting feature is that the water works company owns and operates its own coal mine, taking from the mountains along the river all the coal it uses for pumping and for furnishing electric light to the pumping station and filter plant. In all, the company owns 440 acres of highgrade coal lands.

The coal mine, situated about a mile from the Cahaba pumping station, is entirely



VIEW SHOWING POWER HOUSE, CONCRETE ASH BIN AND COAL HANDLING EQUIPMENT. FROM THE TIME THE COAL IS DUG AT THE MINE ONE MILE FROM THIS PLANT UNTIL IT IS BURNED AND THE ASHES CONVEYED TO STORAGE BIN, ALL OPERATIONS ARE MECHANICAL. THIS NEW POWER HOUSE ALSO CONTAINS LARGE BUNKERS FOR COAL STORAGE.

electrified, and as much use of machinery as possible is made. The mined coal is not touched by hands from the time it leaves the mine until it is hauled away to the dump as ashes. A narrow gauge railway is used to transport the coal from the mine to the station, where it is automatically dumped into a crusher, whence it is carried by conveyors into a 250-ton coal bunker in the roof of the pumping station. From this bunker, it is fed by Taylor underfeed stokers to two new 509-horsepower Babcock and Wilcox boilers, just installed. Coal meters measure the amount of the coal used. The ashes are dropped into a pit, and then blown by steam conveyor into a concrete bin, from which they are dumped into cars and hauled away.

The water as it comes from the river passes through a coarse bar screen to exclude sticks, leaves and other floating material. Before reaching the pumps, it passes through a ¼-inch mesh traveling screen, operated by motor.

Latest equipment at the pumping station includes two new DeLaval steam turbines which have been installed in a large pump pit 40 feet deep and 54 feet in diameter. Each of these turbo-driven pumps has a capacity of ten million gallons per day. With its own coal supply, the company has found it much cheaper to operate steam turbines than to purchase the power and use electrically driven equipment. Three generators are in service at the pumping plant to manufacture such current as is needed for miscellaneous uses around the plant, for the coal mine, for the filter plant, and for the residences of the employees at the pumping station and the filter plant.

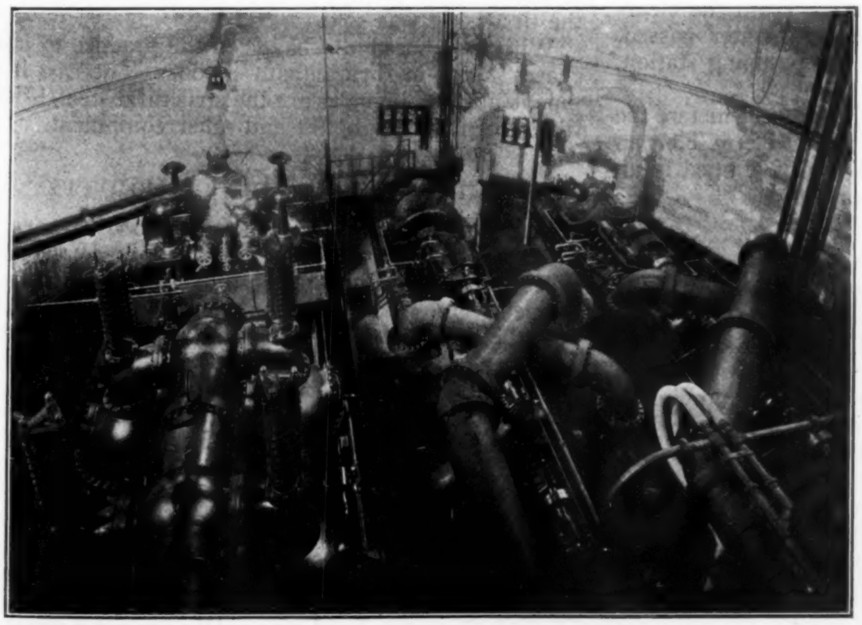
As a reserve in case of emergency, there are six 200-horsepower boilers and two vertical triple-expansion reciprocating pumps, each with a capacity of eight million gallons per day.

Inasmuch as the diversion dam on the Cahaba is far below the pumping station, some provision must be made for the disposal of the sewage from the half dozen houses used by the men operating the Cahaba pumping station. Disposal is accomplished by pumping the sewage over the mountain into the next watershed.

From the pumping station the water is carried in three pipe lines, two 20-inch and one 24-inch, to an equalizing stand-pipe, and thence through two 30-inch lines to the receiving basin of the Shade's Mountain filter plant, in all about three miles horizontally and 458 feet vertically.

FILTER PLANT

The receiving basin at the filter plant has a capacity of 125 million gallons. The settling basin just below has a capacity just in excess of thirty million gallons. In the year 1921 the average turbidity of the raw water was 300, which was reduced by storage in the receiving basin to about 75. In the passage from the receiving basin to the settling basin the water is treated with 8.5 to 17 parts per million of alum, resulting in a further reduction in turbidity to 25. The reduction in bacteria by storage and coagulation varies from 60 per cent. to 75 per cent., as shown in the accompanying table.



LOOKING DOWN INTO PUMP PIT AT CAHABA, SHOWING TWO OF THE NEW DE LAVAL STEAM TURBINES.

At the present time the filtering equipment consists of 38 iron tub filters, each having a capacity of 500,000 gallons a day. There are under construction at this plant eight new concrete filters, each with a capacity of one million gallons a day. The new filters will be similar in design to the old ones, with a perforated metal false bottom, eight inches of gravel, and 30 inches of sand.

Analyses of Water at Plants and at City Taps
Averages for 1921

Cahaba R. Water	Turbidity	Color	Bacteria per c.c.	P. C. of Time gas was found*
Raw	300	97	1060	60
Settled	25	..	415	..
Filtered	0	2	4	8
Effluent	0	2	2	0
Five Mile Creek				
Raw	128	32	1350	75
Settled	20	..	95	..
Filtered	0	2	5	5
Effluent	0	2	2	0
Sampling Points in City				
No. 1	0	2	3	0
No. 2	0	2	2	0
No. 3	0	2	4	0
No. 4	0	2	3	0

*1.0 c.c. Sample on raw water.
10.0 c.c. Sample on filtered and effluent water.

The analysis of the water showed the following averages for 1921:

	Parts per Million
Total Dissolved Solids	107.1
SiO_2	19.2
Fe	0.6
Ca	21.4
Mg	4.01
Nat. K.	8.4
HCo_3	83.0
So_4	11.4
Co_3	0.0
Cl	2.4
No_3	0.8

The bacterial removal of the filters has been very good. Only rarely are 10 bacteria found per c. c. of filtered water, the average being about 5 per c. c.

The filtered water is collected in a clear-water basin 18 feet deep, having a capacity of three million gallons. So clear is the water after filtration, that the bottom of the clear-water basin can be seen distinctly.

A venturi meter a short distance from the clear-water basin registers the amount of water passed. Venturi meters are installed at the pumping station, also.

Just after passing through the venturi meter, the water is sterilized by means of a Wallace & Tiernan automatic chlorinator. The chlorine is applied at an average rate of 0.2 part per million.

FIVE MILE CREEK SUPPLY

The Five Mile creek supply is brought into the city by gravity, part of the way through an open canal and part of the way through a 30-inch pipe line. This water is treated at the North Birmingham plant, where are installed ten tub filters similar to those at the Shade's Mountain plant. Pumping is necessary from the settling basin to the filters, which is accomplished by means of two five-millon gallon centrifugal pumps driven by direct connected Lawrence engines. The chemical treatment at the North Birmingham plant is the same as at the Shade's Mountain plant. After filtration, the water is pumped into the mains.

DISTRIBUTION SYSTEM

From the Shade's Mountain filter plant, the water is brought to the city by gravity, passing through Red Mountain by means of a tunnel 1,100 feet long and 12 feet in diameter. There are two main pipe lines all the way from the filter plant to the city, with a supplementary line part of the distance.

One of the finest residence districts in Birmingham is located on the higher slopes of Red Mountain, far above the city. To give this section an adequate supply of water at a satisfactory pressure the company maintains the Rosedale high service station, and a separate distributing system. At this station, two Janesville pumps take water from the main leading into the city and force it into a standpipe high on the top of Red Mountain.

FINANCES

The rapid and continuous program of expansion which the Birmingham Water Works Company, a privately owned corporation, has been forced to carry through in order to keep ahead of the needs of the community has required the expenditure of large amounts of money. The company has financed improvements by the sale of its preferred stock to its consumers. Last year a half million dollars of cumulative first preferred stock was sold with which to make these improvements. This stock pays a dividend rate of 8 per cent. and is sold at par.

In order to facilitate the purchase of this stock and in order to insure a wide distribution, consumers who could not afford to purchase the stock for cash were given the opportunity of buying on the "Twenty Payment Plan," $5 down and $5 a month. During this time, the purchaser is paid 8 per cent. on his money. This plan met with success and the entire issue was disposed of within a short time. About eighteen hundred consumers own stock in the company.

During the coming year the improvements planned will require a total expenditure of approximately $400,000, which improvements have been approved by the Alabama Public Service Commission; and an additional issue of stock is now being sold to make these improvements on the same plan as the first issue was sold.

Wherever possible it has been the practice to purchase "Made-in-Birmingham" goods. The cast iron pipe is made at home as are the structural steel, brick, tile, cement, meter boxes and other equipment.

Cement-Lined Pipe in Danvers

The municipal water works system of Danvers, Mass., on January 1, 1922, contained more than 20 miles of cement-lined pipe from 12-inch to 4-inch diameter and nearly nine miles of 2-inch to 1-inch, and 32 miles of castiron pipe 20-inch to 4-inch diameter.

Cement-lined pipe is being removed as rapidly as possible, 16.32 miles having been taken up between 1906 and the end of 1921. This is because of the bursts and leaks continually occurring in this kind of pipe. Says Henry Newhall, superintendent of the plant, in his report for 1921: "The number of bursts and leaks on street pipes do not seem to diminish in spite of our renewals with castiron pipe. This would seem to show a universal weakness of all the old cement-lined pipe. We cut out a number by our renewals this year, but too late in the season."

There were 45 breaks and leaks in the mains in

1921. In spite of this, Mr. Newhall reports that a pitometer test of the system last year revealed no leaks in the street mains, indicating, apparently, that leaks are discovered and remedied as soon as they occur.

Repairing Chicago Waterworks Crib

Concrete deck and facing put on rock filled crib anchored to four-mile (intake pier) crib to make landing platform.

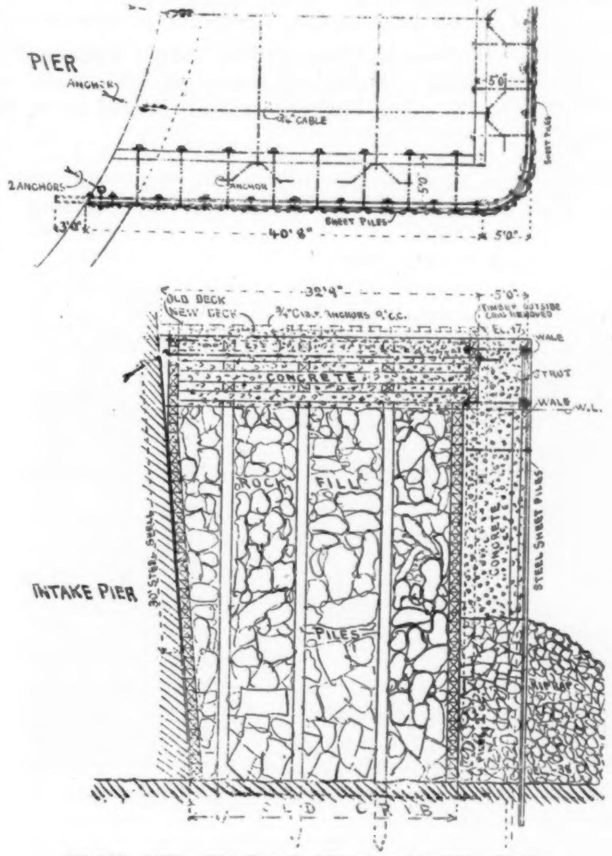
The four-mile crib of the Chicago Water Works Department is a steel shell concrete pier 114 feet in diameter, in water 38 feet deep and extending below the bed of the lake, to provide an intake shaft and connection with the supply tunnel to the city water works pumping station. As a lighthouse and an operating station are maintained on the crib, it is provided with a landing platform which, being exposed to the high waves, needs great mass and strength to resist injury.

It originally consisted of a large rock-filled wooden crib resting on the lake bottom and supporting a trapezoidal timber deck about 40x54x61 feet on the three outer sides and the fourth side formed by a segment of the circumference of the pier. This structure was reinforced with concrete and steel sheet piling.

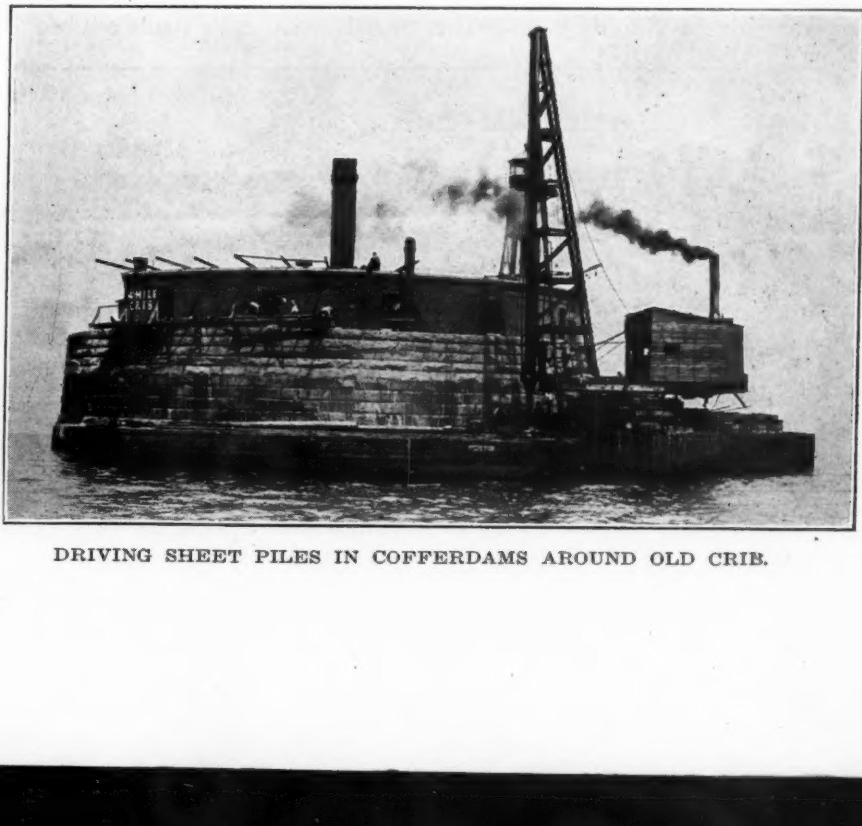
Operations were commenced by removing the sheeting on the outside of the piles and cribbing, removing the deck and drilling eleven 1 1/2-inch equidistant horizontal radial holes in the pier concrete 5 feet above water level on the concave side of the platform. There were inserted in the holes 1 1/4-inch expansion bolts 4 feet long, with eyes that received the loop ends of 1 3/4-inch wire rope cables which passed through the crib and engaged washer plates and long bent anchor bars on the outer faces of the timber. The cables were tightly adjusted to hold the crib firmly in position against the pier.

A continuous wall of 14x3/8-inch Lackawanna steel sheet piles 50 feet long and weighing 41 pounds per linear foot were driven parallel to the three outer sides of the crib and five feet distant from it, except at the corners, which were curved to a long radius. The piles were driven against the outer face of a frame made of two horizontal wales, 5 1/2 feet apart and separated by 5-inch vertical struts riveted to them. The top and bottom wales were each made with a pair of 8-inch horizontal web channels 3 inches apart, back to back, providing clearance for a one-inch horizontal tie rod which passed between them and engaged the crib timbers. The lower wale was supported on the top of a row of round piles about 9 feet apart on centers. The sheet piles took bearing against the outer faces of the wales and at the ends of the line the lower ends of five-pile units were bevelled to fit the batter of the pier masonry. The space between the sheet piles and pier was filled with concrete bags placed by a diver, thus sealing the cofferdam formed around the crib by the sheet piles.

The surface of the rip rap enclosing the cofferdam was levelled and concrete was deposited on it and carried up to water level, filling the space between the sheet piles and the timber crib and enclosing the



PLAN AND SECTION OF REPAIRED PIER.



DRIVING SHEET PILES IN COFFERDAMS AROUND OLD CRIB.

two tiers of anchor rods projecting from the sheet piles. A continuous mass of concrete was deposited on top of the timber crib and rock fill, enclosing the timbers to an elevation of 9 1/2 feet above water level, above which the old timbers were removed and the concrete formed a continuous deck over the old crib and the coffer-dam, holding and protecting all of the ties, cables, wales and struts.

The work was executed by the Bureau of Engineering, Department of Public Works of Chicago under the direction of Myron B. Reynolds, Engineer of Water Works' design.

Decatur's New Water Works Dam

By E. E. Pierson

A two-million dollar dam, financed largely by popular subscription to stock, relieves the city of frequently recurring water shortage. Concrete dam built by use of a steel form in one unit, carried by a traveler.

Decatur, Illinois, is now safe from water famine, for this spring's rains have filled to overflowing its new eight billion gallon reservoir, construction of which began in July, 1920.

The Sangamon river, from which the city draws its supply, is a small stream that runs nearly dry in the summer months, and when the city's population increased by more than 25,000 a few years ago, annual water shortages seemed certain unless radical action were taken at once to increase the dry-weather supply. Some of the leading industries of the city threatened to withdraw their plants if this condition continued.

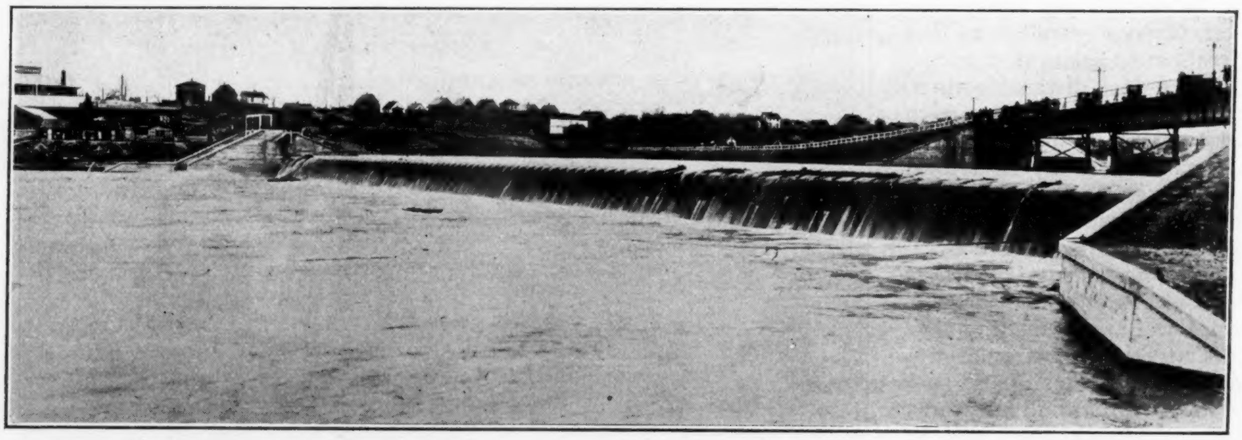
FINANCING THE IMPROVEMENT

By impounding the spring freshets the problem could be solved, but the estimated cost of this was two million dollars, and the city was within half a million of its debt limit. Public meetings were held and popular interest and concern aroused, and, under the leadership of the Association of Commerce, a water supply corporation was formed to finance the project. Within four days after the books had been opened 981 citizens had subscribed for more than the needed amount of stock, and the entire amount has been paid in.

By action of the city council the water rates were doubled, the new figure being twenty-five cents per thousand gallons, yielding $135,000 in annual revenue. This money pays the interest and a portion of the principal each year and in twenty years the entire debt will be paid and no one will feel the burden. The stock pays 7 per cent. interest.

The new corporation, headed by Wilson Bering, former postmaster, bought 4,200 acres of land which would be flooded by the impounded water of the proposed reservoir, paying for it $612,000, ranging from $65 to $200 per acre. Where the owner would not sell for a reasonable figure, condemnation suits, twenty-two in all, were filed. As soon as title had been acquired to the land, the houses and timber were removed at a cost of $100,000 more. The timber felled was given away for firewood.

The original water supply dam raised the water to 595 feet above sea level. The new dam has raised it seventeen feet higher to elevation 612. For the sake of safety and to provide for the future, the 615 contour was taken as the high water mark and everything within this was acquired, including portions of more than sixty productive farms and whole groves of timber. The Sangamon valley and feeding streams had to be prepared for flooding and where public property such as roads and bridges would be inundated by the water of the reservoir, these were raised or relocated. The bridges were raised fifteen feet above the surface of the lake. The cost of changing bridges and approaches and constructing new roads reached $500,000 more.



CONCRETE WEIR SECTION OF DAM, OVERFLOWING FROM RAINS A FEW WEEKS AFTER COMPLETION.

THE PROJECT DESCRIBED

The project, now practically completed, was to construct across the Sangamon river a dam, eleven hundred feet of which was of earth with a concrete core and 550 feet was a concrete spillway thirty feet high. This dams the river back for thirteen miles and gives an average width of half a mile to the reservoir.

In addition to the unlimted supply of water, boating and fishing is provided. Beautiful driveways are being laid out along the shores of the picturesque lake. Shore land is being purchased for summer cottages, camps and clubs, some choice tracts being held by owners as high as $2,000 per acre. Many handsome residences will be built. The city park system has been extended and much of the land acquired by the water company will be utilized for park purposes, 2,600 acres in all being added to the present tracts, including miles of beautiful wooded bluffs, fringing a reservoir lake.

The engineers of the dam were Pearce, Greeley & Hansen of Chicago. J. Abbott Holmes was resident engineer in charge of the work. The contract was let to C. M. Cope of Decatur and J. J. McCabe was superintendent.

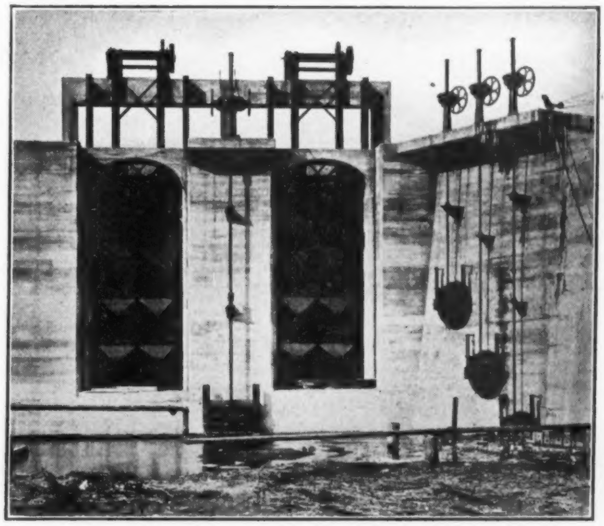
For a foundation of the concrete or weir portion of the dam 46,000 lineal feet of bearing piles were driven. The concrete work was divided into three stages. First the apron below the dam was placed, in alternate sections. Then there was built, supported by the piles, a foundation course six feet thick and thirty feet wide, extending two feet beyond the upstream face of the dam, this also being built in alternate sections. Two longitudinal tongues of concrete were built on the top surface and a channel near the down-stream toe to key it to the structure above. The foundation course was built in a cofferdam constructed by means of steel sheet piling.

The body of the dam rises 22½ feet above the foundation course and is 470 feet long. It was constructed in 18-foot sections, each requiring 250 cubic yards of concrete. In constructiong this, a steel form was used which was suspended from and braced in exact position against a timber traveler. This form was twenty feet long and was built up of angles and plates. Each plate had a hole and cover piece permitting tie rods to be placed in any desired number and position, the tie rods passing through waling timbers on the outside of the form. A wooden bulkhead was placed at the advance end and held in place by one-inch tie rods which extended the full length of the section and were screwed into malleable iron sleeves attached to corresponding rods in the section already constructed. These sleeves were placed just inside the bulkhead so that the short piece of rod extending through the bulkhead could be unscrewed when the bulkhead was to be removed. Similar sleeves were used on the one-inch transverse tie rods just inside the form, and when the form had been released by unscrewing the short rods, the shallow holes were filled with cement mortar.

The bulkhead was so formed as to leave in the vertical joint face vertical recesses 6 by 30 inches to key the sections together. Two recesses were formed in the top of the spillway to permit the hinged steel frames of the flashboard to be lowered during high water.

The traveler that carried the steel form was thirty feet high and thirty-two feet wide. Each side sill was carried by four 9-inch double-flanged wheels that rode upon a rail spiked to timber stringers laid upon the concrete base course. Suspension rods and brace rods, with adjusting ratchets, held the form in position, the concrete toe being secured also by a waling timber, fitted to bolts embedded in the concrete base. The steel form was designed by the Blaw-Knox Company. The concrete was transported upon a trestle erected across the river parallel and close to the dam.

The engineering problems were not complicated and the construction proceeded smoothly after once getting under way. Heavy rains filled the reservoir to its capacity soon after it was completed and water has been pouring over the spillway the greater portion of the spring. Even should not a drop of rain fall for two years, the city of Decatur will have enough water for all possible needs during that period.



GATES AT END OF WEIR SECTION.

LOCATION OF GATES, AT JUNCTION OF EMBANKMENT AND WEIR SECTION.

Water Bond Campaign by Engineers

By R. E. McDonnell

After the failure in 1921 of the $11,000,000 water bond project for Kansas City, the Engineers' Club of Kansas City conceived the plan of conducting an educational campaign in a further effort to carry the bonds, which were urgently needed for a new filtration works, two pumping stations, larger feeder mains, reservoirs and other work. The president of the Engineers' Club, Alexander Maitland, Jr., is also chairman of the new Water Commission. This bi-partisan commission of four men were elected in

1921 to handle the entire new construction and also to operate the present works, thereby removing it from political control. As many engineering questions were involved, it was thought proper to have the Engineers' Club present engineering facts, figures, costs and other data before the 170 civic organizations so that the public could intelligently vote on the project.

Mr. Maitland appointed a water committee of eleven engineers, with R. E. McDonnell, consulting engineer, as chairman. This committee arranged its sub-committees on: Statistics, Filtration, Fire Protection, Typhoid, Present Works, Ozark Supply, Missouri River Supply, Publicity, Speakers, etc., and proceeded to collect and assemble diagrams, data, stereopticon slides, newspaper articles and other information for use before civic and community meetings.

Preliminary to the campaign, a successful effort was made to eliminate all other bond projects, for at the former election defeat was due in a large measure to having eighteen other bond projects up for voting along with the water works. A city campaign was in progress and before political platforms were made public, the leaders of each party were induced to insert a plank favorable to the water works.

After nomination the candidates were pledged to support the bond project.

Prizes were given for water bond slogans; some presented were: "Water the Town and Watch it Grow," "Millions for Water Means Water for a Million," "H_2O, Let's Go." These were put in windows and upon windshields of automobiles. The Engineers' Club discovered that its membership contained many speakers of ability and illustrated talks were given before about sixty of the larger civic organizations. The campaign was also conducted through the schools by talks, first before all the teachers of the city, then before high schools and civics classes. Several thousand high school and grade schools students themselves made four-minute talks upon the water works' needs at classes and before their parents at their homes.

A feature of the proposed improvements was filtration, and the typhoid rates of cities with filtered water were compared with that of Kansas City, which was found to be the largest city in the United States using river water without filtration. Diagrams and statistics were circulated at meetings, showing the health improvement in other cities after filtration.

The partial water softening proposed in the new plant was a campaign hit and was made effective by the speakers giving soap demonstrations with soft water and with the hard water. It was shown that the saving in soap alone would pay the entire bond interest. Demonstrations before audiences of women were both convincing and effective by showing the results of using hard water and then soft water, in washing linens, laces, lingerie, etc.

Records were secured of the people voting at the 1921 election and it was found that only from 7 to 8 per cent. of the membership of civic organizations voted at all. The voting record of each civic club at the previous election was publicly presented, much to their embarrassment and humiliation, for it was found the clubs were strong on civic duty but sadly delinquent when it came to voting. This feature of the campaign was effective in getting out a large vote.

The results of the campaign showed a vote of over 40,000 majority and as a direct result it was found that in one ward where the water works' subject was especially well covered, the vote was 8 to 1 for, while in wards without talks, a bare majority vote was secured.

One beneficial result to the Engineers' Club was the bringing of the engineers prominently before the public in a worthy civic duty performed in behalf of their city.

Springfield Water Works Maintenance

In his report for the year 1922, Alfred E. Martin, superintendent of the Springfield, Mass., water works, mentions several interesting items connected with the maintenance of the system.

He states, for instance, that the pipe trenching machine owned by the department "still continues to prove its usefulness and value. With it we have been enabled to keep our pipe laying gang reduced to its very lowest terms and yet keep our extension and pipe-laying work up-to-date, and twice as much work or even more could be performed if occasion required. It has never yet been worked to its limit." During the past season the department laid eight miles of mains.

The department had so successfully used an electric pipe thawing machine that a second machine of this kind was secured and was ready for service in December, 1920, but since then up to January, 1922, it had not been necessary to use either of them, as no service pipes were frozen.

"This is the first full year of the use of our pipe cleaning instrument, and it has proved to be a very popular as well as money-saving appliance. The average cost of cleaning a 50-foot service is between \$3 and \$5, and it saves anywhere from \$40 to \$80 each time it is successfully used ,and I have yet to hear of a failure. If the pipe is straight, there is absolutely no trouble, but if it changes its direction, the pipe sometimes must be uncovered at the bend, as the tool will not work in a crooked pipe. Very few such services are found, however, and we have cleaned not less than 500 during the year, at an approximate saving to the owners of \$25,000, besides saving the cost of opening and repairing many paved streets."

On November of last year a 36-inch main broke at a point along a country road near Ludlow reservoir. The crack extended the length of one pipe on its lower side. It was repaired by turning the pipe so as to bring the crack on top and acetylene welding it. This was the first and only job of its kind done in this system.

Electrolysis caused two serious impairments to the service during the year. One was in a cast iron pipe and the other in a 42-inch steel main. In the latter case a hole had been eaten through the steel plate due to the breaking of the insulation provided to protect the pipe, thus permitting a flow of electricity to a 6-inch service pipe which crossed directly over the steel pipe.

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CONTENTS

The Water Consumers Be Pleased

In a public meeting recently held by a New Jersey town to discuss the question of a new water supply, one of the citizens stated that, although the chemists and other technical experts assured him that the water, after being filtered and disinfected, was perfectly safe, still he objected to drinking water in which he knew sewage had been discharged, thousands made a practice of bathing in summer, and occasionally dead animals were thrown. The early history of the supply was so disgusting to him that he was unwilling to use it as a beverage.

Another case at point is reported from Decatur, Ill. That city is discussing sewerage for the southeastern section of the city and among the points to be decided is whether the storm water containing the washings from the streets and yards will be discharged above the dam which impounds the water for the city's water supply, or will be carried at greater expense to an outlet below the dam. An editorial in one of the local papers remarks: "It seems to be a part of the old question as to whether the community wishes to tolerate a condition of things which, while not a menace to health, look bad and disturb people with squeamish stomachs."

A generation ago the majority of American cities were drinking diluted sewage and very little was said or thought about it except by sanitarians. Due to the activity of these, and especially of health boards, the entire country has been educated to consider carefully the water which they drink, and the result is shown in the greatly reduced typhoid rates. Having had their attention turned to the subject, however, citizens generally are not stopping at the consideration of safety alone, but are demanding that the water supplied to them shall have passed through no conditions or experiences that tend to excite repugnance or loathing.

Where it is possible to obtain water so acceptable historically as well as chemically and bacteriologically and the people are willing to pay for it, being fully informed as to what the cost will be, there would seem to be no reason why water works officials should not provide them with what they want. In the case of Decatur, for instance, apparently the citizens are to be informed of the additional cost of keeping the street drainage out of their water supply and an opportunity given them to decide whether they desire to pay it.

There are many instances where it is impossible for a community to obtain water which has never been polluted, and in those cases the consumers must be content with such purification and rejuvenation as science is able to furnish.

However, the attitude of some engineers and chemists, that because water is safe the consumers are foolish to object to it merely because of past contamination and should be opposed in their efforts to obtain uncontaminated water, is not in our opinion a proper one. The feeling of dislike which the consumers have for some water supplies is by no means unreasonable, and if they wish to pay the cost of a more acceptable supply, the officials should do everything in their power to meet their wishes in the matter.

Financing Water Works

The raising of funds for extensions and improvements to two water works systems, one a municipal and the other a private, which is described in this issue, offers suggestions that may well be of service to many other cities. In the case of the private plant, nearly a million dollars of 8 per cent. cumulative first preferred stock of the company was sold to the consumers at par on easy terms, about eighteen hundred (six per cent. of the consumers) having become holders of this stock. Besides the raising of needed funds, this is calculated to lessen the feeling of criticism or even animosity that frequently is felt by consumers toward a privately owned plant.

The other article describes how a number of citizens who were engineers carried on a campaign of education to give their fellow citizens the benefit of expert and unbiased knowledge on the subject of a proposed water works reconstruction project, with the result that the bond issue for carrying it out was approved, although a few months previous it had been voted down. This points out one way in which engineers can render important service as citizens.

Decreasing Typhoid Mortality

Figures just published by the U. S. Public Health Service, derived from those of the Census Bureau, show a remarkable reduction in typhoid death rates during the years 1916 to 1920, especially when the low rate already reached by the former year be considered.

The amount of typhoid fever in a community is recognized as one of the best indexes of its healthfulness. So, also, the mortality rate from this cause is a very important sanitary index.

The steadily decreasing mortality rate from typhoid fever is therefore most gratifying. The decrease in the registration States of 1916 was from 13.3 per 100,000 population in 1916 to 7 in 1920. Of the States in the registration area in 1920, Massachusetts and Wisconsin share the honor of having the lowest rate (2.5), while the highest (22.4) appears for South Carolina. Of the 11 States showing rates by color, the lowest rate for the white population was 3.6, and the lowest for the colored was 4.6, both for New York State; whereas the highest rate for the white population was 19.1 for Kentucky, and the

Deaths and Death Rates from Typhoid Fever in the Registration Area (Exclusive of Hawaii) and the Registration States, 1916-1920

Area.	Number of deaths			Rates per 100,000 population				
	1920	1919	1918	1920	1919	1918	1917	1916
Registration area[1]	6,805	7,860	10,210	7.8	9.2	12.6	13.5	13.3
Registration States[2] (1916)	4,890	5,588	7,722	7.0	8.1	11.3	12.5	13.3
California	166	182	196	4.8	5.4	6.0	6.9	6.9
Colorado	87	79	141	9.2	8.5	15.4	10.3	13.2
Connecticut	57	55	72	4.1	4.0	5.4	9.0	7.2
Delaware	25	39	([3])	11.2	17.6	([3])	([3])	([3])
Florida (total)	143	175	([3])	14.6	18.3	([3])	([3])	([3])
White	86	111	.....	13.3	17.7	...	...	...
Colored	57	64	.....	17.2	19.4	...	...	...
Illinois	380	383	519	5.8	5.9	8.2	([3])	([3])
Indiana	284	332	400	9.7	11.4	13.8	17.2	21.2
Kansas	141	129	292	8.0	7.3	16.6	18.8	14.9
Kentucky (total)	490	648	651	20.2	26.9	27.2	35.1	31.1
White	419	536	540	19.1	24.7	25.0	31.6	29.1
Colored	71	112	111	30.2	47.2	46.2	65.9	48.1
Louisiana (total)	280	408	709	15.5	22.8	39.9	([3])	([3])
White	129	221	380	11.7	20.3	35.4	...	...
Colored	151	187	329	21.5	26.6	46.7	...	...
Maine	69	44	59	9.0	5.7	7.7	10.8	11.3
Maryland (total)	100	170	242	6.9	11.8	17.0	18.2	19.0
White	68	112	157	5.6	9.4	13.3	15.8	16.1
Colored	32	58	85	13.0	23.7	35.0	29.4	32.8
Massachusetts	95	105	153	2.5	2.7	4.1	4.9	4.7
Michigan	294	275	334	7.9	7.6	9.4	11.3	12.8
Minnesota	71	79	87	3.0	3.3	3.7	4.3	5.5
Mississippi (total)	333	364	([3])	18.6	20.3	([3])	([3])	([3])
White	99	130	...	11.5	15.3	...	...	...
Colored	234	234	...	25.1	24.9	...	...	...
Missouri	341	426	665	10.0	12.5	19.6	20.8	19.5
Montana	27	39	53	4.8	7.2	10.1	15.7	10.9
Nebraska	58	([3])	([3])	4.5	([3])	([3])	([3])	([3])
New Hampshire	30	15	20	6.8	3.4	4.5	6.1	5.0
New Jersey	105	100	167	3.3	3.2	5.5	6.7	7.1
New York (total)	379	374	585	3.6	3.6	5.7	5.9	6.2
White	369	367	571	3.6	3.6	5.7	5.8	6.2
Colored	10	7	14	4.6	3.3	6.9	7.6	6.3
North Carolina (total)	322	444	570	12.5	17.5	22.8	29.5	28.9
White	167	255	307	9.3	14.4	17.6	23.0	22.1
Colored	155	189	263	19.9	24.5	34.4	44.2	44.0
Ohio	435	457	762	7.5	8.0	13.6	12.6	14.2
Oregon	39	38	73	4.9	4.9	9.5	([3])	([3])
Pennsylvania (total)	503	612	934	5.7	7.1	10.9	10.7	13.9
White	464	574	884	5.5	6.8	10.7	10.4	13.7
Colored	39	38	50	13.4	13.4	18.3	17.8	19.2
Rhode Island	17	20	34	2.8	3.3	5.7	5.8	7.2
South Carolina (total)	379	440	588	22.4	26.3	35.5	31.9	34.2
White	131	130	207	15.9	116.0	26.0	22.6	27.6
Colored	248	310	381	28.6	35.9	44.3	40.3	40.1
Tennessee (total)	434	653	699	18.5	28.0	30.2	38.3	([3])
White	311	462	499	16.4	24.6	26.8	35.1	...
Colored	123	191	200	27.3	42.2	43.9	51.4	...
Utah	31	42	41	6.8	9.4	9.4	13.7	10.7
Vermont	37	11	30	10.5	3.1	8.5	7.1	6.5
Virginia (total)	260	357	407	11.2	15.5	17.9	20.8	24.8
White	157	210	249	9.6	13.1	15.7	15.2	20.6
Colored	103	147	158	14.9	21.3	23.0	33.4	34.2
Washington	76	57	98	5.6	4.2	7.4	9.4	6.2
Wisconsin	65	80	97	2.5	3.1	3.8	5.2	7.9

[1] For the years indicated at top of columns.
[2] Figures in each column reading across are for the States in the registration area in 1916, including the District of Columbia.
[3] Not admitted to registration area until a later date.

highest for the colored was 30.2 for the same State.

Of the 33 States shown for 1919 and 1920 in the accompanying table, only 9 show higher rates in 1920 than in 1919. These States with their rates for 1919 and 1920, are as follows:

State	1920	1919
Colorado	9.2	8.5
Connecticut	4.1	4.0
Kansas	8.0	7.3
Maine	9.0	5.7
Michigan	7.9	7.6
New Hampshire	6.8	3.4
New Jersey	3.3	3.2
Vermont	10.5	3.1
Washington	5.6	4.2

An even more remarkable decline in typhoid rates is reported by the Industrial Department of the Metropolitan Life Insurance Company, based upon the records of approximately 13,500,000 insured persons. Although the total death rate from all causes increased from 966 in February, 1921, to 1,011 in February, 1922, the typhoid rate decreased from 4.0 to 1.9, or more than 50 per cent. A few others showed considerable decrease, especially measles and whooping cough, but no others except these two even approximate the record of typhoid fever.

These figures certainly seem to indicate that those responsible for our water works are to be congratulated upon the good work they are doing. They also show that, so long as eleven states have a rate above 10 per hundred thousand, while thirteen have a rate below 5, there is still abundant room for pronounced improvement in many of the states.

Engineers' Plans for State Health Boards*

Regulations of the State Boards of Colorado, Connecticut and Florida and Delaware, with respect to the matter and form of plans and reports required to accompany applications for water and sewerage permits.

Colorado. Plans not required by law, but generally submitted, and frequently revised in accordance with suggestion of Board of Health.

Connecticut. Plans for *sewerage* should include map showing topography and location of existing sewers and outlets; map showing location of proposed sewers, outlets, manholes, and other accessories; profiles of proposed sewer showing sizes, grades, sections and materials of construction; details of appurtenances; plans for the proposed sewage treatment works, including map of property to be used and detailed plans of proposed works.

For *water works* the plans should include map of municipality; detailed plans of methods of obtaining, pumping, purifying, otherwise treating, storing and distributing the supply; a water shed map showing reservoir development; or if supply is of underground source, map showing topography, water courses, sewers, drains, dwellings, roadways, barns, privy vaults, cesspools and all other sorts of contamination within 1,000 ft. of the proposed source of supply; also details of geological formations giving water bearing strata from which the supply is drawn; and an explanation of the basis of the design and the selection of the proposed source. Also there should be filed with the application complete detailed plans and specifications, report of engineer, and copy of council or town meeting action.

Maps and plans shall be on white paper or black cloth prints. Scale of general plans shall be not less than 300 feet to one inch. Suggested outside dimensions are 22x30 (to be used as standard so far as possible), 11x8½, 25x38 and 22x70 (profiles only). Title, date and signatures shall be in the lower right hand corner.

Blanks are provided for making engineer's reports. These call for quite detailed information. The more important items are as follows:

Water Supply:

Population: Last census, served immediately and designed to serve. Industries. Causes for building system. Is there sewerage?

Quantity: Capacity, gals. per 24 hours; how long before consumption will equal this? Provision for future extensions. Quantity needed immediately for domestic, for industrial and for public purposes.

Source: Surface supply: Name of stream or lake; location with respect to municipality; area of watershed above intake or dam, topography, geology, population on watershed. Principal sources of pollution, sewage and industrial, within 20 miles above intake. Proposed protection of supply (removal of pollution, patrol, purchase, etc.).

Source. Ground water: Location and area of land controlled. Number of inhabitants within 300 feet, 500 feet, 1,000 feet; number and kind of privies within 500 feet. Other sources of possible contamination. Topography of site and surrounding territory.

Wells: Number, kind, size, depth, maximum and minimum distance between. Material, size and depth of casing. Material, type and length of strainer. Kind and thickness of each formation penetrated by well (note water-bearing strata). Distance to nearby body of water and elevation relative to water in wells. Normal yield, if flowing well.

Springs: Number; formation from which each issues; normal yield; distance to nearby body of water and relative elevation.

Rainfall and streamflow: Average yearly rainfall; min. for three driest consecutive months of dryest year. Runoff in sec.-ft., yearly average, max. monthly average, min. monthly average, average May to November; method of obtaining runoff measurements. All streamflow data available.

Reservoir, Impounding: Location of dam; type, materials of construction, length of crest and of spillway, height of crest and of spillway above stream. Elevation of high water and to which water may be lowered. Area of water surface at high and low water, and storage capacity between these; number of days' supply this represents. Average depth of reservoir when full. Area 5 feet or less deep. Preparation of bottom and sides.

Reservoirs, Storage: Location; how filled. Area, depth, capacity; capacity available. Preparation of bottom and sides.

Reservoirs, Distributing or Equalizing: Type and materials of construction (basin, standpipe, elevated tank). Will it be covered? Capacity. Av., max. and min. elevation of flow line above municipality.

Pumps and pumping: Connection of source of supply to pumps. Number, type and rated capacity of low-lift and service. Power used. Station pressure, static and dynamic. Size of discharge main. Provision for meas-

*Continued from page 323.

uring discharge. What records will be kept? Test of ground water supply—duration and rate of continuous pumping; lowering of water level; equipment used.

Treatment: Settling basins; number, capacity, settling period, continuous or fill and draw; disposal of sludge. Coagulation basins; number, capacity, retention period, disposal of sludge; chemicals used and method of handling and introducing them.

Rapid sand filtration: Number, shape, area, materials of construction. Depth, effective size and uniformity coefficient of filtering material. Nominal capacity. Method of washing (air or mechanical agitation, maximum washing head, rise in inches per minute; source of wash water; method of equalizing pressure). Rate controllers and loss-of-head and rate gauges.

Slow sand filtration: Same as above, but substitute "cleaning" for "washing."

Deferrization plant: Describe aeration; chemical treatment; sedimentation basin, capacity, retention period, sludge disposal; filters, number, area, depth and character of filtering material, rate of filtration, nominal capacity, method of washing.

Softening plant: Chemicals used and points of application; reaction period; velocity through reaction chamber. Sedimentation basins, number, capacity, retention period, sludge disposal. Filters, number, area depth and character of filtering material, rate of filtration.

Sterilization: Treatment used and points of application; preparation and application of chemicals; operation continuous or intermittent. Quantities of disinfectant to be used.

Treated water storage: Capacity, material of construction, retention period.

General: Provision for laboratory and analytical control of plant; for collecting samples of water; for conducting test of plant on completion. Will plant be operated continuously or intermittently? Arrangements for expert management. Any unusual features? Number and capacity of wash water pumps, air compressors. Low-lift pumping equipment.

Emergency Supply: If any, describe, with conditions under which it will be used. If used for fire protection by industrial establishment, describe connections.

Distribution: Length and material of each size of pipe. Number of dead ends. Minimum depth of earth covering. Distribution by direct, gravity or combined pressure? Will meters be installed on all services?

Sewerage:

Population:: Total, sewered district, immediately tributary, ultimate provided for, probability of future increase.

Area: Immediately and ultimately tributary.

Rainfall and runoff: Area to be drained, topography, character of soil, per cent. impervious, records of storms, per cent. runoff calculated from above, quantity used in design, how estimated.

Outlets: Construction, elevation relative to high and low water, distance to nearest community and nearest water supply intake; character of stream below outlet, tributary to and use of.

Industrial wastes: Names of industries and character and quantity of waste from each.

System; Combined: Number of manholes, lampholes, catch basins, street inlets; are manholes located at all changes in grade or direction, maximum and average distances between them; ventilating sewers; elevation of ground water, method of making joints in wet and in dry trenches; house connections, sizes, by whom built, will Y's be placed for future? Will cesspools be connected? Number of dead ends; method of flushing; method of trapping catch basins. Plans of storm water overflows, and amount of flow causing them to operate and how estimated.

System; Separate: Any storm, roof or cellar drain water or waste from water motors to enter sewer? Will cesspools be connected? Number of flush tanks and estimated amount of water from them. (Manholes, etc., as for combined system.) Method of ventilating. Ground water elevation. Joints in wet and in dry trenches. To what extent are sewers underdrained?

Size and material: Length and shape of each size.

Pumping: Location of plant, amount to be pumped, lift; type, make and capacity of pump; amount and kind of power. Pumping continuous or intermittent? Amount pumped to be measured?

Screens and screen chamber: Location, method of cleaning and disposal of screenings.

Grit chamber: Dimensions, average, maximum and minimum velocity, disposal of materials.

Treatment Works: Site; water receiving effluent and area and nature of water shed draining it, with area and average depth if lake or pond; average, maximum and minimum estimated flow in second-feet, total and per 1,000 population on watershed. Distance and direction of works from center of municipality and from nearest habitation, and number of habitations within 1,500 feet. Probable development of vicinity of works. Direction of prevailing winds. Area to be used—provision for future extensions. Elevation of high and low water at outlet; levees to protect against floods? Head available in works.

Tanks: Number and kind; daily flow for which designed; provision for measuring flow; number and capacity of units; capacity of sedimentation and of sludge compartments; retention period and nominal velocity; method and frequency of cleaning. Elevations of inlet, outlet, flow line and bottom of tanks, and of sludge beds. Methods of using chemicals, if used.

Dosing Chamber: Location with respect to filters; capacity; kind of dosing apparatus and method of housing it.

Trickling filters: Number, area, material of walls and floor; thickness and limits of size of each class of filtering material; method of underdraining; quantity of sewage designed for, nominal rate in gallons per acre per day; method of application and distribution (distributors, type and spacing of nozzles, head on nozzles, etc.). Number, capacity and depth of final sedimentation basins, elevation of flow line and bottom, and method of sludge disposal.

Contact filters: Practically the same as for trickling filters.

Intermittent filters: Practically the same as for trickling filters.

Disinfection: Kind of chemical and apparatus and method to be used.

Sludge treatment and disposal: Filters; area, material, depth, under-drainage, outlet, depth of flooding. Lagoons; length, width, depth, underdrainage, outlet. Presses, centrifugal machines or other dewatering apparatus. Final disposition of dried sludge, or of wet sludge if not dried.

Delaware. No state control.

Florida. Plans for voluntary observance under preparation similar to those of Ohio and other states.

Legal Snarls in Recent Contracts

Columbus, O., on April 20, received 12 bids for constructing the O'Shaughnessy dam, ranging from $1,001,616 to $1,548,690, the engineer's estimate having been $1,375,300. The contract was awarded to the lowest bidder, but he, claiming that he had made an error in his bid of about $73,000, refused to sign the contract, upon which the director of public service declared his $100,000 check forfeited to the city. The contractor entered suit to recover, the case being heard last week, and it is expected that the decision of the court will be handed down next week. Notice for new bids on May 25th.

Erie, Pa., last month received bids for a 30-inch storm sewer, specifying double-strength pipe. The lowest bid for this was that of the Penn-Erie Construction Company, but another contractor offered to construct the sewer of segment block for $181 less, and that bid was accepted. The Penn-Erie Company, maintaining that the city cannot legally accept a bid not in accordance with the specifications, has obtained a preliminary injunction preventing the awarding of contract to the bidder.

Filter Plant Control and Operation

Recommendations and suggestions by engineers of the Ohio State Health Department and of the filtration plants of a number of Ohio cities, concerning the operation of water filtration plants and the standardization of laboratory practice.

Ohio contains fifty-six water purification plants, serving thirty cities, nineteen towns and seven unincorporated communities. Representatives of forty-six of these last November organized the Ohio Conference on Water Purification. One of three topics discussed at the first conference was "Standardization of Filter Plant Control and Operation." A synopsis of the opinions and conclusions on this topic is given below, and, in view of the high standing of the members of the organization, they deserve careful consideration by, and should prove helpful to, all engineers and superintendents of water filtration plants.

PART I—LABORATORY PRACTICE

COLLECTION OF WATER SAMPLES

It was the consensus of opinion that all samples should be collected in properly sterilized glass bottles protected by metal containers, both of which were subjected to sterilization at the same time. In cases where the containers were sent out from the laboratory the practice would be to secure the stopper by the use of leadfoil or manila paper in addition to the metal container in which the bottle is placed. All samples should be analyzed as promptly as possible. The frequency with which tests shall be made was decided upon as daily for plants having superintendents actively in charge and three times weekly for small plants being supervised.

STANDARD METHODS OF ANALYSES

For convenience these items will be classified first as to bacterial data, and second as to physical and chemical data.

It is important that every filter plant superintendent should own and have available at his plant a copy of the latest edition of The American Public Health Association "Standard Methods of Water Analysis." It was agreed that the above-mentioned work should be the standard for all laboratory work performed by members of this conference. Changes in laboratory practice to conform to the above plan will take effect January 1, 1922. It was recommended that the American Public Health Association and the American Water Works Association reach an agreement as to standard methods of water analysis.

1. *Fermentation Tests.* Lactose broth should be the medium in preference to lactose bile.

It is believed that Dunham tubes are more convenient for the fermentation test.

Fermentation tests should be read at the end of 24 hours and at the end of 48 hours. If 10 per cent or more of gas is noted at the end of 24 hours the test shall be called positive. If gas develops in the amount of less than 10 per cent at the end of 24 hours, or if gas develops in any amount in 48 hours, it shall be called a doubtful test. If no gas develops at the end of 48 hours it shall be called a negative test. The symbols for these results shall be (+ ? —).

2. *B. Coli Confirmation.* The State Department of Health will not require confirmation of B. coli but will accept the presumptive B. coli tests as sufficient in reporting results of filter plant operation. The manner of reporting B. coli confirmation shall be in terms of B. coli index per 100 cc.

3. *Bacteria per cc.* It was the consensus of opinion of the conference that for the purpose of determining the number of bacteria per cc, the use of agar was preferable to gelatin and that counts should be made at 20 degrees in preference to counts at 37 degrees.

The State Department of Health suggested that for those plants now equipped to make both 20 degree counts and 37 degree counts, the routine procedure would be the reporting of counts at 20 degrees for each step in the process and counts at 37 degrees for raw water and final product. Small plants not equipped with 20 degree incubators will not be expected to purchase equipment to follow the suggested routine, but will make 37 degree counts for each step in the process. The question of adopting a standard of reporting 20 degree counts in preference to 37 degree counts was left until the next conference for action.

4. *Expression of Results.* To avoid fictitious accuracy, bacterial counts shall be expressed according to the advice given in standard methods of water analysis.

5. *Media.* For medium size and large filter plants it is desired that media be prepared according to the A. P. H. A. standard methods in preference to dehydrated or desiccated preparations such as the Difco brand. For small plants and for field work the dehydrated products are reasonably satisfactory.

6. *Sterilization.* Glassware shall be uniformly sterilized according to the latest advice of the A. P. H. A., viz., 170 degrees C. for one and one-half hours. Culture media shall be sterilized according to the latest advice of the A. P. H. A., viz., steam pressure of 15 pounds for 15 minutes at a temperature of 120 degrees C.

The following determinations representing the physical and chemical tests called for in filter plant operation were discussed.

7. *Temperature.* This test should be made upon raw water and reported as degrees centigrade.

8. *Turbidity.* On account of great discrepancies in observing turbidities by different methods, it is felt that this test should be made using a candle turbidimeter. It is satisfactory to substitute an electric light for the standard candle and according to the advice given in A. P. H. A. standard methods. It was agreed that turbidities under thirty may be measured by bottle standards.

9. *Alkalinity.* To eliminate variations in al-

kalinites reported, erythrosin should be the indicator used in measuring total alkalinity. It was agreed that methyl-orange may be used in place of erythrosin but that erythrosin be used occasionally as a check upon methyl-orange.

10. *Color.* Color reported should be that in true solution and as obtained upon a water sample filtered through filter paper until the filtrate is clear. The manner of making the test should be either by the use of U. S. G. S. color disc equipment, or by the use of platinum cobalt standards.

11. *Hardness.* It is believed that hardness calculated from the calcium and magnesium content is most accurate and should be the method used in preference to the soap hardness test. The manner of determining calcium and magnesium may be either gravimetric or volumetric, preferably the latter as being the simpler.

12. *Incrustants.* Up to the present time the soda reagent method as indicated in A. P. H. A. standard methods is probably best adapted for filter plant work in determining incrustants; with the possible exception that when attempting to soften to a very low point, certain modifications of the method indicated may be desirable.

Experiences with determination of incrustants (remarks by C. P. Hover): "In testing hard water softened to a low degree, such as for boiler work, the presence of large excess of caustic alkalinity interferes with the action of the soda reagent method. Research work on an improved method under these circumstances is being carried out."

Experiences in the laboratory of the State Health Department (remarks by R. D. Scott): "In testing excessively hard waters care must be used to have an excess of the soda reagent, which may be accomplished by reducing the volume of sample tested or increasing the amount of soda reagent called for by standard methods."

13. *Iron.* The volumetric or colorimetric method of the A. P. H. A. is satisfactory.

For routine filter plant reports upon hardness, incrustants, and iron, the State Health Department will consider satisfactory these determinations upon monthly composite samples.

PART II—PLANT OPERATION

STORAGE AND SEDIMENTATION

Control of Algae Trouble. The use of copper sulphate at monthly intervals and in small amount throughout the warm weather season, beginning, say, the first day of April, has proved effective in preventing the growth of algae in reservoirs. It may prove advantageous to use the copper sulphate treatment in filtered water and well water reservoirs that are exposed and that act as equalizers on the distribution system. Some hesitancy was expressed by the conference regarding the advisability of applying copper sulphate in filtered water reservoirs.

COAGULATION

1. *Application of Chemicals.* The value and importance of purchasing chemicals on specification cannot be over-estimated. The most important chemical to specify is lime, which should be ordered on the basis of water soluable CaO.

The strength of solution to employ for coagulants should be such as to minimize clogging of the orifices.

Iron sulphate or sulphate of alumina solutions need to be agitated after the mixing up of the tank full; if mechanical agitators are available 20 minutes agitation is not too much; if compressed air only is available the same time of agitation should be used.

Avoid applying lime to the suction of the pump or ahead of a Venturi meter. Use an eductor in preference to pumping lime solutions.

Avoid using lime in plants not designed for the use of lime. The proper employment of lime requires adequate mixing chamber and settling basins.

2. *Measurements of the Amount of Chemicals.* The exact quantity of chemicals used each day is desired and should be easily obtainable. In the case of dry feed the quantity is definite, and in the case of solution feed, known strengths of solution should be employed and record made of amount used daily. It seemed to be the sentiment of the conference that some of the existing types of dry feed apparatus were not as satisfactory as is claimed by manufacturers of the device. Many expressions were heard favoring solution feed of chemicals in preference to dry feed.

3. *Secondary Coagulant Feed.* All plants operating intermittently should employ secondary feed for coagulants especially when starting up to insure the proper floc in the influent water upon the filters.

4. *Condition of Floc in Influent Water.* Besides procuring a measurable floc, it is evident that the quality of the floc produced in the influent water should be proper. For plants using sulphate of alumina an amount measurable to 15 parts per million turbidity is almost a minimum; if sulphate of iron is being used, perhaps 20. The conference expressed the opinion that it was not possible to measure the quality of floc in the influent water but that each operator would have to rely upon his own judgment as to what constituted proper floc.

FILTRATION

1. *Use of Fine Sand for Filters.* Mr. Dittoe read abstracts from his paper which was presented before the New York meeting of the American Public Health Association, November 15, 1921. (This paper was abstracted in PUBLIC WORKS for November 29, 1921.)

2. *Sand Incrustation.* A careful check on the amount of phenolphthalein alkalinity carried in the influent water for plants using lime will materially assist in keeping the growth of sand at a minimum. The alternate use of sulphate of alumina and sulphate of iron with lime as coagulants will relieve this burden somewhat.

3. *Rates of Filtration.* It was the opinion of the conference that rates of filtration should be kept as low as possible consistent with plant demands. In any event for Ohio conditions, the rates of filtration should not exceed 125 m.g.a.d.

4. *Broken Filter Runs.* When necessary to decrease the filtering capacity needed to meet peak demands, throw out of service the filters having longest been in service and wash them. Do not cut out of service a filter without washing, thinking to put it back in service later. Opinions were expressed that under certain circumstances, such as in the case of a plant having a relatively small clear well, the foregoing practice would not be possible.

5. *Long Filter Runs.* Adjust the loss of head for washing to prevent excessive long runs. Do not allow filters to become air-bound even slightly,

since such condition may disturb the mat on the filter and ruin filter efficiency.

6. *Filter Washing.* Do not wash filters too long, but leave sufficient flocculent material to provide for the initial mat upon the filter.

7. *Filtering to Waste.* In all plants provided with re-wash valves or filtered waste valves, operate these valves a sufficient time after a filter has been washed to produce a good effluent.

8. *Operation of Valves.* Open and close all valves slowly, allowing perhaps one minute for the time of operation. This applies particularly to washwater valves.

Hydraulic valves should be operated from the individual controls on the operating table and not by the water main control.

9. *Level of Sand.* Adjust the sand level in your filter plant to correspond with the rate of washwater used in washing. Make the distance between top of sand and top of washwater trough approximately equal to the rate of rise in inches employed in washing.

10. *Washing with Air and Water.* Plants having both compressed air and washwater should follow a practce of filter washing, allowing the filter to drain to about six inches water level from the top of sand. Apply air alone until well distributed. Apply water with air until water level is up to top of troughs. Shut off air and wash with water alone.

11. *Loss-of-Head Gages.* Repair your loss-of-head gages and gage the length of filter runs according to the readings of the loss of heads in preference to a schedule of washings.

12. *Special Filter Operation in Periods of Algae Trouble.*

In a paper on this subject, F. H. Waring, principal assisant engineer of the State Board of Health, advised giving regular wash to filters at same intervals as under normal conditions, and limiting time of wash to three minutes, with one or more intermediate one-minute washes. If intermediate washes are required at intervals of less than one hour, disturb clogged surface as follows: Leave sewer closed, shut effluent, turn on full wash water rather quickly and then close, put filter in service again by opening effluent. This "disturbing" may be used once or twice between partial washings. Use air instead of water for disturbing if it is available.

13. *Mud Balls.* Occurrence of mud balls usually means faulty conditions of washing of the filters. Look for underdrain troubles.

Overcome the temporary condition by scraping off mud accumulation early and remedy the washing or other difficulty.

14. *Hydraulics of Filter Underdrain and Distributing System.* Place an indicating pressure gage on the main wash water entering the manifold of each filter underdrain and distributing system, and keep watch over the pressures in washing. An increasingly high pressure denotes impending filter troubles.

15. *Effluent Taps.* Guard against an isolated bad filter condition which would ruin the whole plant efficiency by sampling the filter effiuent from each filter at least occasionally. An ordinary sampling tap or spigot on the effluent line in the pipe gallery is preferable to a sampling pump for bacterial samples.

DISINFECTION

1. Apply chlorine to the filtered water.

2. The amount of chlorine applied should be from .1 to .2 parts per million if the filtered water is up to standard.

3. Liquid chlorine is preferable to the use of hypochlorite on account of dependability.

If hypo solution is to be used it is necessary to analyze each tank full in order to scientifically control the application.

Water Services and Meters

Data from more than six hundred cities concerning meters and services; including the average life in the different cities of wrought iron, steel, lead, cast iron and other services, causes of deterioration, methods of cleaning clogged sewers, unusued services laid preparatory to paving, etc.

The falling of prices has had its immediate effect upon water works construction. In some cases the connection is direct—work is being begun that had been needed for months and years but put off because of high prices. Other expenditures are indirect—low prices have stimulated building construction, and more buildings means more mains, and especially more services, and that means corporation and curb cocks, curb boxes, meters, etc. Returns made to us show present demands for a thousand miles of water mains, a hundred thousand meters and other water works appurtenances and appliances in proportion.

The tables in this issue, compiled from information furnished by over eight hundred water works officials, deal with some interesting features of water works practice. For instance, of 547 plants that use meters on residence services, 495 use ⅝-inch meters, with occasionally larger ones for unusually high demands; 32 use no size smaller than ¾-inch; while 20 use ½-inch for ordinary residences.

Wrought iron and steel, either galvanized or black, is used for services by the majority of plants, although quite a number use lead. More report using wrought iron than steel for services; and of the expectations of use this year, seven times as much wrought iron as steel is reported. One superintendent, however, expresses what is a more or less common belief when he says, in his reply to our questionnaire: "We ask and pay for wrought iron, but I suspect that we are getting steel." As the

(Continued on page 351)

Table I—Use of Meters and of Check Valves

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Alabama:				
Apelika	no	no	......	3/4"
Bessemer	yes	......	......	5/8"
Gadsden	yes	only lines supplying boilers	no	5/8" and 3/4"
Jasper	yes	no	......	5/8"
Mobile	yes	no	......	5/8" and 3/4"
Montgomery	......	where necessary	not used in residence service	5/8"
Sheffield	yes	in some cases	no	5/8"
Talladega	yes	no	......	5/8" and 3/4"
Arizona:				
Phoenix	yes	only in extreme cases	no	5/8" and 3/4"
Arkansas:				
Arkadelphia	yes	......	no	5/8" and 3/4"
Batesville	yes	no	......	5/8"
Ft. Smith	......	no	......	3/4" and 5/8"
Harrison	yes	no	......	5/8" and 3/4"
Jonesboro	yes	no	......	5/8"
Mena	yes	yes	no	5/8"
Pine Bluff	yes	no	......	5/8"
California:				
Long Beach	yes	no	......	3/4"
Pasadena	yes	no	......	5/8" and 3/4"
Pomona	no	no	consumer charged damage to meter on acc. of check	5/8" and 3/4"
Riverside	no	only where boilers are used	no	5/8"
San Jose	yes	occasionally	no	5/8"
Santa Barbara	yes	no	......	5/8"
Santa Cruz	yes	only where boilers are attached	no	......
Colorado:				
Boulder	yes	yes	no	5/8"
Colo. Springs	yes	no	......	only large services metered
Ft. Collins	yes	no	......	5/8"
Greeley	yes	only where there is hot wated trouble	no	5/8"
Longmont	yes	where necessary	no	5/8"
Rocky Ford	yes	no	......	5/8"
Connecticut:				
Ansonia	yes	no	......	5/8"
Bridgeport	yes	no	......	3/4" and 5/8"
Danielson	yes	no	......	......
Derby	......	no	......	......
Middletown	......	no	no	5/8"
Norwich	placed on all new services	......	......	5/8"
Putnam	yes	no	......	5/8"
Torrington	......	no	......	1/2"
Wallingford	yes	on separate hot water heaters	no	5/8"
Willimantic	yes	no	......	5/8"
Florida:				
Gainesville	yes	no	......	5/8"
Jacksonville	......	......	......	5/8"
Lake City	no	no	......	5/8"
Live Oak	yes	no	......	3/4"
Indiana (Continued).				
Crown Point	yes	no	......	5/8"
Decatur	yes	no	......	5/8"
East Chicago	yes	yes	no	5/8"
Elkhart	yes	no	hot water backs through meter and burns out parts	5/8"
Elwood	yes	some	no	5/8"
Ft. Wayne	yes	only where boilers and coils are on service	no	5/8" and 3/4"
Gas City	yes	no	......	5/8" and 1/2"
Greenfield	yes	in some instances	no	5/8"
Greensburg	yes	no	......	5/8"
Huntington	yes	only where suplying steam boilers	no	5/8"
Indianapolis	no	yes	no	5/8"
Jasper	no	no	......	3/4"
Lafayette	yes	where hot water may get to meters	no	5/8"
La Porte	yes	yes	very little	5/8"
Lebanon	yes	no	......	5/8"
Linton	yes	no	......	5/8"
Marion	yes	......	no	5/8" and 3/4"
Mishawaka	yes	no	......	5/8"
New Albany	no	......	no	5/8"
New Castle	no	no	frequently	5/8"
South Bend	yes	no	......	5/8"
Tell City	yes	no	......	5/8" and 3/4"
Terre Haute	......	......	......	5/8"
Tipton	yes	where service is to boilers	no	5/8" and 3/4"
Union City	yes	where there is hot water plant or coil in furnace	no	5/8"
Vincennes	yes	no	......	5/8"
Iowa:				
Algona	yes	no	......	5/8" and 3/4"
Boone	yes	no	......	5/8"
Burlington	......	no	consumers pay repair if meter is damaged by hot water	......
Cedar Rapids	yes	no	......	5/8" on 3/4" service
Council Bluffs	yes	no	......	5/8"
Davenport	yes	no	when meter scalded consumer pays cost	5/8"
Eldora	furnished by city	no	......	5/8"
Ft. Dodge	yes	no	......	5/8"
Harlan	yes	on hot water only	no	5/8"
Independence	yes	sometimes	yes	5/8"
Iowa Falls	yes	no	......	5/8"
Maquoketa	yes	where power or heating boilers are used	no	5/8"
Marion	yes	in some cases	no	5/8"
Mason City	yes	no	......	1/2" and 5/8"
Muscatine	yes	with safety valve	no	5/8"
New Hampton	yes	no	......	5/8"
Sac City	yes	no	......	5/8"
Sioux City	no	yes	no	5/8"
Storm Lake	yes	no	......	1"
Valley Junction	yes	yes	no	3/4" and 5/8"
Washington	yes	no	......	5/8"

Georgia:				
Athens	yes	no	......	⅝"
Atlanta	yes	no	......	⅝", ¾" service
Bainbridge	yes	no	......	⅝" and ¾"
Covington	......	no	......	¾"
East Point	yes	no	......	⅝"
Griffin	yes	no	......	⅝"
La Grange	yes	no	......	⅝"
Marietta	all serv. metered	no	......	⅝"
Moultrie	yes	no	......	⅝"
Pelham	yes	no	......	¾"
Rome	yes	only on hotels and large buildings	no	⅝"
Savannah	yes	......	......	⅝" and ¾"
Thomasville	yes	no	......	⅝"
Idaho:				
Boise	yes	no	......	¾"
Illinois:				
Abingdon	yes	yes	very little	⅝"
Bloomington	yes	no	......	⅝"
Bushnell	yes	only when necessary	recommend relief valve	⅝"
Centralia	yes	no	......	⅝", ¾" connections
Chicago Heights	yes	if connected to hot water system	no; use safety valve	⅝" and ¾"
Christopher	yes	no	......	⅝"
Decatur	yes	in some cases	no	⅝"
Depue	yes	yes	no	⅝"
Downers Grove	yes	no	......	⅝"
Effingham	yes	no	......	⅝"
Elmhurst	yes	no	......	⅝"
Freeport	yes	no	......	⅝"
Geneva	yes	no	......	⅝"
Harrisburg	yes	no	......	⅝"
Harvard	yes	only where connected to water heater	not yet	⅝", ¾" connections
Harvey	yes	yes	safety valve installed	⅝"
Lake Forest	yes	in few instances	no	⅝" and ¾"
Lawrenceville	yes	no	......	⅝"
Lincoln	yes	no	......	⅝"
Mattoon	......	in a few instances	no	⅝"
Moline	yes	no	......	⅝", ¾" connections
Morrison	mostly flat rates	no	no	⅝"
Naperville	yes	......	......	⅝"
Peoria	yes	no	......	⅝"
Princeton	yes	where needed	no	⅝"
Quincy	on some services	yes	no	⅝" or ¾"
Riverside	yes	no	......	⅝"
Rock Island	yes	where meter is damaged by hot water from boilers	......	⅝"
Rockford	yes	no	......	⅝"
St. Charles	yes	no	......	⅝"
Springfield	yes	no	......	⅝"
Streator	yes	no	......	⅝"
Vandalia	few meters	no	......	¾"
Waukegan	yes	yes	no	⅝"
West Chicago	yes	no	......	⅝"
Indiana:				
Auburn	yes	no	......	⅝"
Aurora	yes	no	......	⅝"
Bedford	yes	......	......	⅝"
Bluffton	yes	no	......	⅝"
Brazil	yes	......	......	⅝"
Columbia City	yes	in special cases	......	⅝"
Crawfordsville	no	no	......	⅝"

Kansas:				
Atchison	no	no	......	⅝"
Chanute	yes	no	no	⅝" and ¾"
Coffeyville	no	only where hydraulic elevators are used	no	⅝"
Eureka	......	no	......	⅝" and ¾"
Ft. Scott	yes	no	......	⅝"
Fredonia	yes	no	......	⅝"
Galena	yes	no	......	¾"
Girard	yes	no	......	⅝"
Great Bend	yes	no	......	⅝", ¾" connections
Hays	yes	only when adjacent to boilers	no	⅝"
Hutchinson	yes	no	......	⅝"
Independence	yes	no	......	⅝", ¾" connections
Lyons	yes	a few	install pressure regulator and relief valves	⅝"
McPherson	yes	no	......	⅝"
Olathe	......	no	......	⅝"
Osawatomie	yes	no	......	⅝"
Pittsburg	yes	no	......	⅝"
Salina	yes	where hot water backs up to meter	no	⅝"
Topeka	yes	......	......	⅝"
Kentucky:				
Ashland	yes	no	......	⅝"
Catlettsburg	no	no	......	⅝", ½" connections
Covington	yes	......	......	⅝"
Lexington	yes	not general on residences	no	⅝"
Louisville	yes	yes	no	none
Morganfield	yes	no	......	⅞"
Providence	yes	sometimes	no	½" and ⅝"
Louisiana:				
Baton Rouge	yes	on some with tank pressure	no	⅝"
Leesville	yes	no	......	⅝"
Rayne	yes	no	......	⅝"
Maine:				
Augusta	yes	in laundries	no	⅝" and ¾"
Bath	no	yes	no	⅝", ¾" connections
Eastport	......	no	......	⅝"
Lewiston	no	no	......	⅝"
Portland	yes	no	yes; when check used	½"
Maryland:				
Chestertown	......	no	......	¾"
Hagerstown	yes	yes	no	⅝"
Massachusetts:				
Andover	......	no	no	⅝"
Arlington	yes	......	......	⅝"
Athol	yes	no	......	⅝"
Belmont	yes	where there is pressure boiler	yes	⅝"
Boston	......	......	......	⅝"-1"
Brockton	yes	no	......	⅝"
Brookline	......	where hot water is liable to flow back	no	⅝"
Cambridge	optional with water dept.	......	......	⅝" on ¾" pipe
Clinton	......	......	......	⅝"
Concord	......	no	......	none
Danvers	yes	against hot water	yes	⅝"
Dedham	......	no	......	⅝"
Easthampton	no	no	......	⅝"
Everett	yes	no	......	⅝"

Use of Meters and Check Valves—Continued

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Massachusetts (Continued).				
Fairhaven	yes	no	......	⅝"
Fitchburg	yes	some	no	⅝"
Framingham	yes	no	......	⅝"
Haverhill	yes	no	......	⅝"
Hudson	yes	no	......	⅝"
Lawrence	yes	no	......	⅝" to ¾"
Lenox	no	no	......	⅝" to ¾"
Maynard	yes	no	......	⅝"
Medford	yes	no	......	⅝"
Milford	yes	no	......	⅝"
Montague	no	......	......	......
Needham	yes	no	......	⅝"
New Bedford	yes	no	......	⅝", ¾" and 1" occasionally
N. Attleborough	no	only on sizes supplying boilers	no	⅝"
Norwood	yes	no	......	⅝"
Oxford	yes	no	......	⅝"
Peabody	yes	no	......	⅝"
Reading	yes	no	......	⅝"
Springfield	yes	on 3" up	no	⅝"
Swampscott	yes	no	......	⅝"
Taunton	yes	no	......	⅝"
Waltham	yes	no	......	⅝"
Wareham	yes	no	......	⅝"
Wellesley	no	when asked only	no	⅝"
Westboro	yes	no	......	⅝"
Winthrop	yes	no	......	⅝" single houses; ¾" double and apartments
Wrentham	optional	no	......	⅝"
Michigan:				
Alma	yes	no	......	⅝"
Ann Arbor	yes	when necessary	very few	⅝"
Battle Creek	no	no	few long ago	⅝"
Big Rapids	no	......	......	¾" when used
Detroit	yes	no	......	⅝"
Dowagiac	yes	in some cases	no	⅝"
Escanaba	yes	where hot water heating	no	⅝"
Gladstone	yes	on large meters	......	⅝"
Greenville	yes	no	......	⅝"
Highland Park	yes	yes and diaphragm rel'f valves	no	⅝"
Holland	yes	no	......	⅝"x⅝"
Ironwood	no	no	......	⅝"
Marine City	no	flat rate	......	......
Marquette	yes	no	......	⅝"
Marshall	yes	no	......	⅝"
Menominee	......	some	no	⅝"
Mt. Clemens	......	no	......	⅝"
Mt. Pleasant	......	no	......	⅝", ¾" connec'ns
Niles	yes	no	......	⅝"
Onaway	yes	no	......	½" & ¾"
Rochester	yes	yes	no	⅝"
Saginaw	yes	no	......	only meter large services
St. Clair	yes	no	......	⅝", ¾" connec'ns
South Haven	yes	in few cases where relief is installed	no	⅝"
Sturgis	yes	on hot water heating systems only	......	⅝"
Three Rivers	no	only on large heating plants	......	⅝", ¾" hubs
Traverse City	yes	no	......	⅝"
Wakefield	yes	no meters	......	no meters
Nebraska (Continued).				
McCook	yes	no	......	⅝"
North Platte	yes	no	......	⅝"
Schuyler	......	no	......	⅝"
Sidney	yes	......	......	⅝" & ¾"
University Pl	yes	no	......	⅝"
New Hampshire:				
Berlin	yes	up to consumer	some	⅝"
Claremont	yes	where necessary	no; relief valves used	⅝", ¾" connections
Concord	yes	no	......	⅝" & ¾"
Dover	yes	no	......	⅝" & ¾"
Keene	yes	no	......	⅝"
Lebanon	no	no	......	⅝"
Portsmouth	......	no	......	⅝"
New Jersey:				
Bound Brook	yes	in some cases	no	⅝" & ¾"
Bridgeton	yes	no meters	......	......
Dunellen	yes	no	......	⅝" & ¾"
Freehold	yes	no	......	⅝"
Hawthorne	yes	no	......	⅝"
Hightstown	yes	no	......	⅝"
Milltown	by boro ordinance	yes	no	⅝", ¾" spuds
Nutley	yes	no	......	⅝"
Phillipsburg	......	no	......	⅝"
Ridgewood	yes	......	......	⅝" & ¾"
Rockaway	yes	no	......	⅝" & ¾"
New Mexico:				
Silver City	yes	no	......	⅝" & ¾"
New York:				
Albany	yes	when necessary	no	⅝"
Amityville	......	no	......	⅝"
Auburn	yes	no	......	⅝"
Avon	......	on some	yes	⅝"
Babylon	......	......	......	⅝"
Baldwinsville	no	where required	......	none metered
Brockport	yes	no	......	⅝"
Buffalo	city ordinance	no	......	⅝"
Canastota	yes	no	......	⅝"
Catskill	no	no	......	⅝", ¾" connec'ns
Clyde	no	no	......	⅝"
Corning	yes	yes	no	⅝"
Cortland	yes	no	......	⅝"
East Aurora	yes	no	......	⅝"
Elmira	yes	no	......	⅝"
Fairport	yes	no	......	⅝"
Fort Plain	no	when boilers attached	no	⅝"
Frankfort	yes	no	......	½" or ⅝"
Freeport	yes	no	......	......
Geneva	yes	yes	......	⅝"
Glens Falls	yes	on some industrial services	no	⅝"; ⅝" & ¾"
Gloversville	yes	yes	no	⅝"
Hamburg	yes	no	......	1", 1¼", ⅝"
Hoosick Falls	no	no	......	⅝"
Hudson	yes	no	......	½"
Hudson Falls	yes	yes	no	⅝"
Ithaca	yes	in rare cases	no	⅝"
Jamestown	yes	few	no	¾"
Le Roy	yes	no	......	⅝", ¾" connec'ns
Lyons	yes	no	......	⅝"
Middletown	yes	no	......	⅝"
Mohawk	yes	no	......	⅝"
Mount Morris	yes	no	......	⅝"

Minnesota:				
Aurora	yes	no	......	⅝"
Brainerd	97% metered	used by individuals	in few cases to meters only	⅝"
Cloquet	yes	no	......	⅝"
Crookston	yes	no	......	⅝" & ¾"
Duluth	never tested	no	......	⅝"
Hastings	yes	yes	no	⅝"
Hutchinson	yes	no		⅝"
Lake City	yes	on all hot water and range boilers	......	......
Little Falls	no	no	no	⅝"
Luverne	yes	no	......	⅝"
Minneapolis	yes	no	......	⅝' dup and apt ¾"
Northfield	yes	no	......	⅝"
Pipestone	yes	when connected to boiler	......	⅝"
St. Cloud	yes	no	no	⅝"
St. Paul	yes	yes	......	⅝"
Staples	yes	no	no	⅝"
Stillwater	yes	no meters	......	¾"
Two Harbors	no	no meters	......	......
Waseca	yes	no	......	⅝"
W. Minneapolis	yes	yes	......	⅝"
Worthington	yes	no	no	¾"
Mississippi:				
Canton	yes	only where there is hot water trouble	no	⅝" x ¾"
Clarksdale	yes	no	......	⅝"
Greenville	yes	where steam boilers are used	no	⅝" x ¾"
Greenwood	yes	no	......	⅝"
Grenada	yes	no	......	⅝"
Jackson	yes	on high pressure steam boilers	no	⅝" x ¾"
Laurel	......	......	......	⅝"
Meridian	yes	no	......	⅝"
New Albany	yes	no	......	⅝"
Winona	all metered	no	......	⅝" & ¾"
Missouri:				
Butler	yes	no	......	......
Hannibal	yes	yes	......	⅝"
Jefferson City	yes	no	......	⅝"
Lebanon	yes	no	......	⅝"
Liberty	all metr'd	a few	no	⅝"
Macon	no	in some cases	......	⅝" or ¾"
Marceline	......	no	......	-¾"
St. Louis	yes	where hot water damage occurs	......	⅝"
Trenton	yes	where necessary	no	⅝"
Webster Grove	yes	no	......	⅝"
Montana:				
Anaconda	yes	no meters	......	......
Billings	yes	when meters damaged by water from boilers	in few cases	⅝"
Glendive	yes	where close to hot water line	no	⅝"
Great Falls	yes	no	......	¾"
Missoula	yes	when there are boilers	require safety valves	flat rate
Nebraska:				
Aurora	......	......	sometimes hot water backs into meters	¾"
Chadron	yes	no	......	⅝"
Fairbury	yes	no	......	⅝" & ¾"
Fremont	yes	no	......	⅝" & ¾"
Gering	yes	yes	no	⅝"
Hastings	yes	no	......	⅝"
Lincoln	yes	......	......	⅝"
Mount Vernon	yes	yes	no	½" & ¾"
Newark	yes	no	......	⅝"
New York	on business premises only	in bldgs. supplied from 2 mains & supply to boilers	no	⅝", ¾" spuds
Norwich	not known	only when hot water has backed through meter	......	
Nyack	at option of bd.	when liable to back pressure	no	⅝"
Ogdensburg	yes	yes	no	......
Olean	all metr'd	no	......	⅝"
Oneonta	yes	no	......	⅝"
Ossining	no	no	......	⅝"
Oswego	yes	yes	no	⅝"
Perry	for industrial purposes	no	......	......
Rochester	yes	only on large sizes	no	⅝"
Salamanca	yes	only on boilers under st'm pressure	......	⅝"
Saratoga Sp'ngs.	yes	no	......	⅝"-¾"
Scotia	city furn. meters	no	......	⅝"
Seneca Falls	yes	no	......	⅝"
Sidney	yes	no	......	......
Syracuse	99%	where 2 mains on large meters	no	¾" & ⅝"
Tarrytown	yes	not in all cases	possibly	⅝"
Wapp'gers Falls	yes	no	......	⅝"
Waterford	yes	no	......	⅝" & ¾"
Waterloo	......	no	......	⅝"
Watertown	some	no	......	⅝"
Watervliet	yes	not ordinarily	no	⅝"
Wellsville	yes	no	......	⅝"
Westfield	no	no	......	¾"
Yonkers	yes	......	......	⅝"
North Carolina:				
Canton	yes	no	......	⅝"
Greensboro	yes	no	......	⅝"
High Point	no	no	......	⅝", ¾" connec'ns
Lenoir	yes	yes	no	¾"
Monroe	......	no	......	⅝", ¾" serv. pipe
Morehead City	no	no	......	½" & ¾"
Mount Airy	yes	only on boiler services and cross connections w. private supplies	no	⅝"
New Bern	yes	only when trouble from hot water	no	⅝", ¾" connec'ns
Rocky Mount	yes	no	......	⅝"
Salisbury	yes	only certain hot water supplies	no	⅝", ¾" connec'ns
Wilmington	yes	no	......	⅝"
North Dakota:				
Fargo	yes	no	......	⅝" & ¾"
Grafton	yes	no	......	⅝"
Valley City	yes	no	......	⅝"
Wahpeton	yes	no	......	¾"
Williston	yes	some	yes	⅝"
Ohio:				
Ashtabula	yes	......	......	⅝"
Barberton	yes	no	......	⅝", ¾" connec'ns
Barnesville	yes	no	......	⅝"
Bryan	yes	no	......	⅝"
Cambridge	yes	no	......	¾" to ⅝"
Cincinnati	yes	in case of water heaters	no	⅝"
Cleveland	yes	not on 1" or less	no	⅝"
Cuyahoga Falls	......	......	......	⅝"
Dayton	......	where there is hot water	no	½"
East Liverpool	yes	on large services	no	⅝" and ¾"

Use of Meters and Check Valves—Continued

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Ohio (Continued).				
E. Youngstown	......	no	......	5/8"
Eaton	yes	when necessary	no	1/2" and 5/8"
Franklin	yes	on large meters	no	5/8"
Kenmore	yes	no	......	5/8"
Lakewood	yes	no	......	5/8", 1/2" couplings
Lancaster	yes	no	......	5/8" or 3/4"
Lima	yes	no	......	......
Lorain	yes	no	......	5/8"
Marysville	yes	some	no	5/8" and 3/4"
Medina	yes	no	......	5/8", 1/2" connections
Middletown	yes	no	......	5/8"
Mingo Junction	yes	no; stop valve	no	5/8"
Montpelier	yes	no	......	5/8"
Newark	yes	no	......	5/8"
New Boston	by ordinance	on outlet	in few cases	5/8",
New Phila.	yes	no	......	5/8"
Niles	yes	no	......	5/8"
Portsmouth	by ordinance	no	......	5/8" and 3/4"
Sandusky	yes	on some	no	5/8"
Springfield	yes	when connected with boilers	no	5/8"
Tiffin	yes	yes	no	5/8", 3/4" connections
Wadsworth	yes	no	......	5/8"
Warren	yes	no	......	5/8"
Willoughby	yes	no	......	5/8"
Youngstown	yes	no	......	5/8"
Zanesville	yes	no	......	5/8"
Oklahoma:				
Cleveland	yes	no	......	3/4"
Collinsville	yes	no	......	5/8"
Hartshorne	yes	safety valve on hot water boilers	no	5/8"
Holdenville	yes	no	......	5/8"
Newkirk	yes	no	......	5/8"
Sand Springs	yes	no	......	5/8"
Pennsylvania:				
Allentown	yes	yes	no	5/8"
Bloomsburg	no	no	......	......
Catasauqua	yes	......	......	5/8"
Chambersburg	yes	when hot water sets back	no	5/8", 3/4" couplings
Chester	yes	no	......	5/8"
Coatesville	no	no	......	5/8" and 3/4"
Connellsville	partly	in some cases	no	5/8"
Coudersport	......	no	......	none
Corry	yes	few	no	5/8" and 1/2"
Downingtown	yes	no	......	5/8"
Duquesne	yes	on property side	no	5/8"
Ellwood	yes	no	......	5/8"
Hamburg	yes	no	......	5/8"
Honesdale	yes	no	......	3/4"
Huntingdon	yes	not regularly	no	no meters
Indiana	......	yes	......	5/8" and 3/4"
Jenkintown	yes	yes	no	1/2" and 1"
Jersey Shore	yes	only when hot water is apt to back up to meter	no	5/8" and 3/4"
Juniata	borough legislation	no	......	3/4"
McDonald	yes	no	......	5/8"
McKees Rocks	......	no	......	5/8"
Manheim	yes	no	......	5/8"

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Texas (Continued).				
Sweetwater	yes	no	......	1/2" and 3/4"
Teague	......	no	......	1/2"
Texas City	all metered	at certain hot water appliances	no	5/8" and 3/4"
Waco	yes	only on fire line service	hot water backs up in meter	......
Vermont:				
Barre	yes	no	......	5/8"
Proctor	no	......	......	......
Springfield	yes	no	......	5/8"
Virginia:				
Charlottesville	to meter 100%	no	......	5/8" and 3/4"
Harrisonburg	yes	no	......	5/8", 3/4" connections
Lynchburg	by ordinance	no	......	5/8" and 3/4"
Martinsville	no	some	none	5/8"
Richmond	yes	occasionally; also safety valve near boiler	no	5/8" and 1"
Staunton	yes	no	......	5/8"
Washington:				
Seattle	placed on each new serv.	no compulsion	no	1/2", 3/4" and 1"
Spokane	yes	no	......	5/8" and 3/4"
West Virginia:				
Charleston	Pub. Serv. Com. orders	only in boiler rooms	no	5/8"
Moundsville	Pub. Serv. Com.	no	......	5/8"
Salem	yes	no	......	5/8"
Sistersville	no	no	......	3/4"
Welch	yes	no	......	5/8"
Wisconsin:				
Appleton	yes	in some locations	no	5/8"
Clintonville	yes	only when connected to high pressure boilers	......	5/8"
Delavan	yes	no	......	5/8"
Fond du Lac	no	where hot water plants connected	......	5/8"
Ft. Atkinson	yes	no	seldom	5/8" and 3/4"
Green Bay	yes	no	......	5/8"
Hartford	yes	no	......	3/4"
Janesville	yes	no	......	5/8"
Jefferson	all metered	no	consumer responsible for meter	5/8"
Kaukauna	yes	only where required for steam boilers	no	5/8"
Lake Geneva	yes	yes	no	4" to 5/8"
Madison	yes	no	on heater lines only	5/8"
Manitowoc	yes	yes	no	5/8"
Marinette	yes	only where there is hot water connection	no	5/8"

Media	Pub. Serv. Com.	yes	no	⅝"
Meyersdale	no	no	......	⅝"
Millersburg	Pub. Serv. does	no	......	⅝"
North East	yes	no	very seldom	⅝"
Reading	yes	yes	no	⅝"
Red Lion	no	both	no	flat rate
Reynoldsville	yes	no	......	½"
Royersford	no	no	......	⅝" and ¾"
Sayre	......	no	......	⅝"
Sharpsville	yes	no	......	½"
Sykesville	yes	yes	no	⅝"
Tamaqua	no	no	......	¾"
Tyrone	no	yes	no	⅝"
Uniontown	yes	no	......	⅝"
Warren	no	no	......	⅝"
Wellsboro	yes	no	......	½"
Wilkinsburg	yes	no	......	⅝"
Williamstown	no	at plant of Lt. Co.	......	......
York	yes	yes	no	none metered
Rhode Island:				
Woonsocket	yes	no	......	⅝"
South Carolina:				
Anderson	yes	where hot water heating systems are used	no	⅝"
Batesburg	yes	no	......	⅝"
Bennettsville	by city ordinance	only in special cases	no	⅝", ¾" connections
Camden	yes	no	......	⅝"
Charleston	yes	not generally	no	⅝" and ¾"
Cheraw	yes	no	......	⅝", ¾" connections
Clinton	yes	no	......	¾"
Easley	yes	in some cases	no	⅝"
Spartanburg	rule of bd.	no	......	⅝", ¾" service
South Dakota:				
Aberdeen	yes	no	......	⅝"
Tennessee:				
Elizabethton	yes	no meters	......	......
Erwin	yes	no	......	⅝"
Greeneville	yes	no	......	⅝"
Lebanon	mun. owned	no	......	¾"
Memphis	yes	in some cases	no	⅝"
Newport	yes	no	......	⅝"
Shelbyville	yes	yes	disturbing noises	⅝"
Trenton	yes	no meters	......	......
Texas:				
Austin	yes	no	......	⅝"
Big Spring	yes	no	......	⅝" and 1"
Cleburne	yes	no	......	¾" and ⅝"
Cooper	yes	no	......	⅝"
Dalhart	optional	no	......	⅝"
Electra	yes	no	......	¾"
Hearne	yes	no	......	⅝" and ¾"
Henrietta	yes	yes	no	⅝"
Mart	yes	no	......	½" and ¾"
Paris	yes	no	......	⅝"
Quanah	yes	where boilers are on line	no	⅝" and ¾"
San Antonio	no	sometimes	no	⅝"
Smithville	yes	no	......	⅝"
Stamford	yes	no	......	⅝" and ¾"
Menasha	yes	only if hot water backs up	no	⅝" and ¾"
Milwaukee	yes	only where supply comes from two streets	no	⅝" and ¾"
Mineral Point	yes	no	......	⅝"
Monroe	yes	no	......	⅝"
Neenah	yes	when connected to hot water system	no	⅝" and ¾"
New London	yes	no	......	⅝"
Park Falls	yes	no	......	⅝"
Platteville	yes	no	......	⅝"
Plymouth	yes	no	......	⅝"
Racine	yes	in some cases	no	⅝"
Reedsburg	yes	no	......	⅝"
Rice Lake	yes	yes	no	⅝"
Richland Center	yes	no	......	¾"
Shawano	yes	no	......	⅝"
S. Milwaukee	yes	no	no	⅝"
Sparta	yes	no	......	⅝" and ¾"
Stevens Point	......	no	......	⅝"
Sturgeon Bay	yes	no	......	⅝"
Superior	yes	no	......	⅝"
Tomah	yes	no	......	⅝"
Tomahawk	yes	yes	no	¾"
Viroqua	yes	no	......	¾"
Watertown	city ordinance	only on boilers	no	⅝"
Wauwatosa	yes	no	......	⅝" and ¾"
Wyoming:				
Cheyenne	yes	no	......	⅝"
Evanston	yes	no meters	......	......
Rawlins	yes	no	......	¾"

(Continued from page 345)

former costs about 80 per cent. more than the latter, it would seem to be worth while to make sure of getting what is paid for.

Even more interesting are the opinions given as to the lives of services of the different materials. In all cases where comparisons are made, we believe, wrought iron is assigned a longer life than steel, and lead much longer than either. A few such comparisons (using the abbreviations for brevity) are: S, 20; wi, 35; l, 50. S, 5 to 10; wi, 25 to 30. Wi, 15; l, 25 to 35. S, 15; wi, 30. S, 12; wi, 25; l, 50. S, 2 to 8; l, 30. Wi, 15; l, permanent. S, 15; l, indefinite. Wi, 15 to 20; lead lined, indefinite. Gal., 20 to 25; cement lined, 50. The causes of deterioration are generally given as rust or corrosion; although quite a number report electrolysis, and a few freezing and bursting of lead pipes.

Several hundred describe briefly the methods they employ in removing stoppages from service pipes. These include rodding, forcing wads of tissue paper through, use of force pumps, pumping muriatic acid through, running wires, tapes or small pipes through; while many make no effort at cleaning but renew all clogged services. An unexpected number report that they are not troubled with clogging of service pipes. This is true of seven cities out of eight in Alabama, six out of seven in Arkansas, all in California, thirteen out of seventeen in Kansas, etc. On the other hand, all Maine cities report such trouble, and twenty-three of thirty-six in Massachusetts.

Table II—Water Works Services

Note: In the table, ci. means cast iron; cl., cement lined; gi., galvanized iron; gs., galvanized steel; gwi., galvanized wrought iron; i., iron; ll., lead lined; s. steel; wi. wrought iron.

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes	
				Does it occur?	Method of removal.
Alabama:					
Bessemer	½" g.	15	corrosion	no	....
Gadsden	g.	15-20	rust	no	....
Jasper	g.	10	rust	no	....
Mobile	wi.	8	rust	yes	rodding
Montgomery	l.	30 and more	electrolysis	no	....
Opelika	ci. and cl.	......	....	no	....
Sheffield	g. and l.	30	rust	no	....
Talladega	g.	20	action of soil	no	....
Arizona:					
Phoenix	g. and wi.	15	elect., rust and corrosion	yes	flushing
Arkansas:					
Arkadelphia	ci.	......	....	no	....
Batesville	¾" g.	20 and more	....	no	....
Ft. Smith	g.	18-20-35	rust	little	....
Harrison	g.	20	rust	no	....
Jonesboro	wi.	6 and more	....	no	....
Mena	¾" g.	20	rust	no	....
Pine Bluff	¾" g.	15-25	rust	no	....
California:					
Long Beach	gs.	g. 15; l. 40	rust	no	....
Pasadena	s. and ¾" g.	20	elect., corrosion	no	....
Pomona	wi.	20-30	rust	no	....
Riverside	wi.	25	elect., rust	no	....
San Jose	s.	30	elect., rust, alkali	no	....
Santa Barbara	wi.	10-20 (a)	chem. action of soil	no	....
Santa Cruz	wi.	25-30; s. 5-10	....	....	replaced with new
Colorado:					
Boulder	wi.	20	....	no	....
Colo. Springs	s., wi., l.	s. 20; wi. 35; l. 50	rust	rust only	renew
Ft. Collins	wi.	15-25	rust	no	....
Greeley	l.	......	....	no	....
Longmont	l., wi., s.	s. 6-30	rust, corrosion	yes	renew
Rocky Ford	l. under pav., rest g.	g. 6-15	from sediment in water	....	laying new ones
Connecticut:					
Ansonia	wi.	......	rust	....	....
Danielson	gs.	20	rust	some	extension rods
Derby	......	......	clogging	yes	pipes renewed
Middletown	wi.	25-30	clogging	yes	force pump
Norwich	l.	......	electrolysis	yes	blow them
Putnam	g.	25	rust—det. at joints	yes	relay, mostly
Torrington	s., wi., l.	......	rust	yes	lay new pipe
Wallingford	wi.	¾", 30-35; 1", 40-50	rust	....	....
Willimantic	l.	35	....	no	....
Florida:					
Gainesville	wi., l. ci.	wi., 10-20	wi.—rust	no	....
Jacksonville	g.	15-25	elect., rust	no	....
Key West	l.	......	....	very little	....
Lake City	i. and l.	......	....	no	....
Live Oak	l	......	....	....	....
Georgia:					
Athens	g.	15	none	yes	renewed
Atlanta	wi., l. connect.	15-20	....	....	....
Bainbridge	wi.	10	rust	no	....
Covington	gs.	......	....	no	....
East Point	g.	10	electrolysis	no	....
Griffin	wi.	15	rust	few	renew
La Grange	gs.; ll. under new pavements	s., 20	rust	little	renew
Marietta	wi.	30	rust	none	....
Moultrie	wi.	12	corrosion	no	....
Pelham	l. and wi.	......	....	yes	renew
Rome	s. and wi.	15	elect., rust	no	....
Savannah	s., wi., l., ci.	wi., 10	rust	little	flushing
Thomasville	gs.	18-20	rust	....	....
Idaho:					
Boise	g.	25	elect., ordinary det.	no	....
Illinois:					
Abingdon	i. and l.	i., 10	rust	no	....
Bloomington	l., ci.	l., 30	bursting of lead pipe freezing	yes	pump acid thru; sometimes comp. air
Bushnell	s. and l.	i., 5-20	rust, action of water	no	....
Centralia	l. and g.	g., 10-20	rust	yes	services renewed
Chicago Heights	l.	......	electrolysis	some	disconnect and clean
Christopher	s. and l.	s., 6-8	elect. and rust	yes	renew
Decatur	g., wi.	25	....	no	....
Depue	l., g.	......	rust	no	....
Downers Grove	l.	i.-3	rust	no	....
Effingham	wi. and l.	i., 12, l.-25	rust	no	....
Elmhurst	l.	......	....	no	....
Freeport	l.	30	fill. w. sediment	occasionally	renew serv.
Geneva	l.	18	rust	no	....
Harrisburg	wi. and l.	wi.-15, l., 25-35	rust	no	....
Harvard	l.	......	rust	some	muriatic acid
Harvey	l.	25-40	cinders	no	....
Lake Forest	l.	wi.-18	rust	no	....
Lawrenceville	g.	5	curb stops, rust off service. Line pitted	seldom	....
Lincoln	wi.	20	rust., elect.	little	force pump
Mattoon	wi. and g., s.	s., 15, wi. 30	elect., rust	no	....
Moline	l., g.	25	elect., rust	no	....
Morrison	g., wi.	......	rust	no	....
Naperville	l.	......	....	no	....

*For footnotes see page 359.

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes— Does it occur?	Method of removal.
Illinois (Continued).					
Peoria	l.	......	electrolysis	some	force pump
Princeton	l., i. and s.	i. and s.-15-20	rust	occasionally	flushing
Quincy	l., ci.	c.-3-15	rust	no	....
Riverside	l., wi.	wi., 8-10	elect. & minerals in water	yes	....
Rock Island	l.	......	....	....	....
Rockford	l.-up to 1½ ci.-2" up	......	elect., rust	no	....
St. Charles	l.	......	....	no	....
Springfield	l., wi.	50	iron in water	yes	force pump
Streator	g., wi., l.	......	....	no	....
Vandalia	wi.-unpaved and l., pav. sts.	......	rust	some	flushing
Waukegan	l., wi.	wi., 20-30	rust	no	....
West Chicago	l.	......	none	no	....
Indiana:					
Auburn	l.	......	elect.	some	pump out
Aurora	wi. and l.	7-10	rust	....	....
Bedford	s. and wi.	12-16	rust	no	....
Bluffton	l.	......	....	no	....
Brazil	g.	25	rust	no	....
Columbia City	l.	......	....	yes	pumping
Crawfordsville	g., wi.	20	....	yes	take out gooseneck
Crown Point	l.	none in 25 yrs.	....	yes	flexible ribbon sometimes prevents renewal
Decatur	l.	none in 25 yrs.	....	....	....
East Chicago	l. g.	......	....	....	....
Elkhart	l.	......	....	occasionally	wired
Elwood	wi.	15	electrolysis	....	....
Ft. Wayne	l.	40	little elect.	....	force pump
Gas City	......	......	....	yes	dig up and clean
Greenfield	wi.	10	rust	yes	flush
Greensburg	g.	15	action of earth salts and imperfect pipe	yes	pumping wad of paper through
Hobart	l.	......	mechanical defect	yes	air
Huntington	l.	s., 12; wi. 25; l. 50	electrolysis	.005%	force pump
Indianapolis	l.	50	....	no	....
Jasper	......	10-20	....	no	....
Lafayette	l.	48 and more	water hammer, elect.	yes	force pump
Lebanon	l. and i.	......	rust., elect.	no	....
La Porte	l., gwi.	l.-50; rest-30	rust	no	....
Linton	wi.	15	pitting	some	insert wire and flush
Marion	g.	20	rust., elect.	no	....
Martinsville	ci.	25	none	in serv. lines	blow out
Michigan City	l., wi.	20-50	rust	no	....
Mishawaka	l.	i.-15	corrosion due to soil	some	flexible rod
New Albany	g., wi.	15	elect. mostly	....	force pump
New Castle	gwi.	25-30	rust, elect.	little	flexible ribbon sometimes soft material
South Bend	l.	......	....	yes	renew
Tell City	s. and ci.	8-10	elect., rust	no	....
Terre Haute	l.	s.-20	electrolysis	no	....
Tipton	g., l.	10-20	elect., rust, defect. pipe	no	....
Union City	l. and s.	l.-30 s., 2-8	elect., rust	no	....
Vincennes	wi.	35	elec., weakness in lead gooseneck	no	....
Whiting	l. and g.	......	no elect.	no	....
Iowa:					
Algona	wi., l.	10-12	rust	some	....
Boone	l.	......	....	no	....
Burlington	wi. g., l., ll.	15-i.	rust, elect.	....	....
Cedar Rapids	l., i.	l.-15-30	rust	no	....
Council Bluffs	ci., l.	depreciate c.i. 1% and g. 7%	elect., rust	yes	none cleaned
Davenport	l; 1" or more wi. or ci.	......	l. above 1" bursts because of raising fire pressure in mains	no	....
Eldora	g., l.	10	elect., rust	no	....
Ft. Dodge	l. und. pav., wi. inside lot line	......	....	yes	....
Harlan	wi., l.	s-short	electrolysis	no	flush
Independence	l.	4-5	rust	yes	renew
Iowa Falls	l.	......	....	some	....
Maquoketa	wi. and l.	wi.-15 l-permanent	rust	no	....
Marion	l.	......	....	....	....
Mason City	l.	......	....	no	....
Muscatine	l.	50	none	no	....
New Hampton	g., l.	i., 12-14	rust	seldom	install new
Sac City	l. gooseneck; some gs.	i., 20 s., less	rust	no	....
Sioux City	l.	12-30	none	yes	....
Storm Lake	wi.	12	rust	no	....
Valley Jct.	wi.	......	....	....	....
Washington	l.	......	none	no	....
Kansas:					
Atchison	wi.- s., formerly	s., 20	rust	very little	force pump—back pressure
Chanute	l. and s.	s.-3-12 l.-18+	....	no	....
Coffeyville	gs. and l.	s.-15 l.-indefinitely	rust—s.	no	....
Eureka	ci. and g.	30+	....	no	....
Fort Scott	g.	20	corrosion	no	....
Fredonia	wi. and l.	......	l., bad joints; wi., rust	no	....
Galena	ci.	38+	....	no	....
Girard	l.	......	....	....	....
Great Bend	gs.	20-30	rust	no	....
Hays	ci., wi.	small s.; sew.-7	rust, chem. action	no	....

*For footnotes see page 359.

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes — Does it occur?	Clogging of service pipes — Method of removal.
Kansas (Continued).					
Hutchinson	g., wl.	......	elect., rust	not much	flushing services
Independence ..	g., wl. and gs.	s., 4-15 wl., 10-30	electrolysis	yes	....
Lyons	s.	......	rust	no	....
McPherson	l. under pavt. rest wl.	20-25	rust	no	....
Osawatomie	l.	......	none	no	....
Pittsburg	l.-paved sts., wl.-unpaved	l.-20	electrolysis	no	....
Salina	g.-l. (b)	g., 15-20	....	no	....
Topeka	l., wl.	l., 30; wl. 15	....	yes	acid
Kentucky:					
Ashland	gwl.	30+	elect., acid in soil	no	....
Catlettsburg ...	gwl.	25	electrolysis	no	....
Covington	l.	......	....	....	....
Hazard	gs.	......	rust	....	....
Lexington	l.	......	electrolysis	no	....
Louisville	l.	......	damage b- other pub. serv. corporations	very little	flushing
Morganfield ...	l.	30+	....	....	....
Providence	l. and g.	g., 7	rust	....	....
Louisiana:					
Baton Rouge ..	l.	......	few necessary	no	....
Kentwood	s.	9+	....	very little	....
Leesville	s.	10	rust	yes	dig up and renew
Rayne	g.	10+	damages from cars on side sts.	no	....
Maine:					
Augusta	ll.	s., 15, wl. 20—	rust	yes	Staples service pipe cleaner
Bath	wl.	20	rust	yes	by pressure pump
Eastport	gs.	5-20	rust	some	....
Lewiston	wl. and ll. (d)	wl., 15-20 ll.-indef.	rust on wl.	yes	by turn. rod and cutter Staples clean mach.
Portland	gwl. and cl.	g.-20-25 cl.-50	rust	yes	¼" block tin pipe
Maryland:					
Hagerstown ...	gwl., ll.	25	electrolysis	no	....
Massachusetts:					
Andover	ll.	......	....	....	pressure pumps
Arlington	cl.	......	....	very little	tubing pipes
Athol	gwl.	15	rust	yes	by blowing out service toward main against pressure with tissue paper plug
Belmont	wl., cl., ll., g.	......	rust	in g.	Staples spudging mach.
Boston	l., cl. (e)	......	....	at connection	blowing paper pellet through w. force pump
Brockton	g., cl., cl.	g., cl.-20-30	g. rust, cl. elect. or breakage	very little	forced out with pump under pressure
Brookline	cl., wl.	cl.-45+	rust	no	....
Cambridge	ll.	12	corrosion of old g.	yes	Staples cleaning rods
Clinton	s. cl., wl. cl. & ll.	40+	rust	some	flexible rod, dig
Concord	cl., l.	wl., 15-18 cl., 25	wl. rust	....	....
Danvers	cl.	10-40	rust	no	....
Dedham	cl.	32+	....	....	....
Easthampton ..	wl.	40	rust	no	....
Everett	l.	35	corrosion	some at corp. cock	force pump w. wad of paper—sometimes dig up corp. cock
Fairhaven	l., g.	g.-10	rust on l.	yes	dig up and scrape out rust
Fitchburg	cl., wl.	50+	rust	some	run in small pipe
Framingham ...	wl. up to 2" 3" and up-cl.	cl., 2-20 wl.—25+	elect., rust	no	....
Haverhill	l.	l.-50+	rust, elect.	rarely	....
Hingham	gwl., cl.	wl.-25	corrosion inside	yes	by running wire through and by pressure pump
Hudson	cl., gwl.	20-40	rust	some	wire out
Lawrence	l.	25-30	rust at coup. or curb	....	pressure
Lenox	s.	30+	rust	no	....
Maynard	cl., wl.	30+	....	yes	with wire put in service from cellar
Medford	cl., cl.	25+	rust at connections	yes	force pump and wiring
Milford	gwl., cl.	wl.-25 cl.-40+	rust	some	force paper plug through
Montague	g.	......	electrolysis	no	....
Needham	cl. and ll.	32+	....	in 1 org.	drill
New Bedford ..	l. up to 1" cl.-over 1"	wl., 10-15 l., 55+	rust in wl.	very little	forcing wad of paper through
Newburyport ..	wl., cl.	......	rust at joints	some	....
N. Attleboro ...	l.-¾"	30+	rust. in wl. and joint of l.	not with l.	....
Norwood	wl., cl.	20	rust	very little	rods, force pump, etc.
Oxford	g.	......	....	no	....
Peabody	ll., formerly wl.	wl.-15-30	rust and sediment from water	yes	renew
Reading	wl.	20	wall settling and elect.	yes, cl.	blow out
Springfield	wl. and ll.	20-wl.	elect and rust	yes	Staples cleaner
Swampscott ...	wl., cl.	10	rust	yes	pumping and rods
Taunton	cl., wl.	30-40	acidity of soil	some	force pump or wiring out
Waltham	cl., wl.	20-25	rust	very little	block tin forced through with water on; bad cases, force pump with water on
Wareham	brass	15	rust in form of scale	....	renewal
Wellesley	wl., l., ll., cl., cl.	......	wl.-rust	....	renew
Westboro	wl.	18	rust	no	....
Winthrop	l.; g. in past	g.-8-10	rust	....	force pump; relay with l.
Wrentham	wl.	15+	....	no	....

*For footnotes see page 359.

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes — Does it occur?	Method of removal.
Michigan:					
Alma	l. under pav; wi. and s. —	wi. and gs.-20	rust	no	....
Ann Arbor	wi.	20	rust	on old serv.	force pump, rods
Battle Creek	See Note (f)	g., 20-40 ci., 100-200	elect.; little rust	none	....
Bay City	l.	......	....	no	....
Big Rapids	wi.	......	....	....	....
Crystal Falls	g.	......	sometimes pipes freeze and split	sometimes	force pumps
Detroit	l. and ci.	......	....	....	....
Dowagiac	wi. and l.	wi.-30	rust	rarely	with wire
Escanaba	wi. g. with l. on gooseneck	33+	....	no	....
Gladstone	g.	20	rust in joints	no	....
Greenville	g.-serv to curbs	30+	....	no	....
Highland Park	l.	......	....	no	....
Holland	gs.	20+	rust	no	....
Ironwood	g.	......	....	no	....
Marine City	l. and wi.	l., 20-25	rust on outside of pipe	some	force pump back pres're
Marquette	g.	25	rust., elect.	no	....
Marshall	s.	18	elect. oxidizes l., so only use goosenecks at main	yes	blowing out with air pressure
Menominee	s.	......	rust	no	....
Mt. Clemens	l.	25	electrolysis	no	....
Mt. Pleasant	wi.	15-30	rust	yes	with cable and water
Niles	l.	......	rust	no	....
Onaway	s. and wi.	......	rust	no	....
Rochester	g., wi., s.	g., wi.-27+	electrolysis	no	....
Saginaw	l.	40	electrolysis	yes	force back with 150 lb. pump
St. Clair	l. and g.	......	electrolysis	yes	force pump
St. Louis	l. and s.	......	....	yes	air pressure
South Haven	s., wi.	......	rust	no	....
Sturgis	l.	30	....	no	....
Three Rivers	l.	......	rust	yes	using high pressure of compressed air and blowing from meter to mains
Traverse City	gwi.	25-30	rust	no	....
Wakefield	l.	25	....	no	....
Minnesota:					
Aurora	gl. and gooseneck	......	....	yes	wire tape or steam
Brainerd	g.	15-18	rust	no	Edison diaphragm pump
Cloquet	g.	......	....	no	....
Crookston	wi. and l.	wi., 15	rust	no	....
Duluth	l.	......	electrolysis	little	force pump
Hastings	g.	......	rust	yes	new goose necks and corp cocks
Hutchinson	wi. and l.	wi., 10	elect., rust	no	....
Lake City	wi. and l.	wi., 14	rust	....	flushing
Little Falls	......	......	rust	no	....
Luverne	l. and wi.	wi., 16	rust	yes	blow out; renew
Minneapolis	l.	......	....	no	....
Northfield	l.	......	....	no	....
Pipestone	l.	gi., 20; l., 10+	rust on g.	no	....
St. Cloud	g.	......	....	no	....
St. Paul	l. up to 1½"; ci. 2" and over	30	elect., corrosion	no	force pump used occasionally
Staples	gwi.	......	....	no	....
Stillwater	wi.	20-25	electrolysis	no	....
Two Harbors	l.	l. formerly used, 15	iron in red clay gave out first	no	....
Waseco	l.	gi., 12	rust	yes	....
W. Minneapolis	wi. and l.	......	....	....	....
Worthington	ci. and wi.	wi., 5-10	rust	yes	....
Mississippi:					
Canton	gs.	15-20	rust	no	pump w. comp. air
Clarksdale	wi. and l.	......	....	no	....
Greenville	wi. and l.	wi., 10-20	rust	no	....
Greenwood	l. and i.	l., 2-10	rust	no	....
Grenada	wi. and l.	......	....	no	....
Jackson	l. under pav.; g. no pav.	g., 12	rust	some	rod out or by comp air
Laurel	l. under pav.; others s	s., 15	elect. and rust, s.	no	....
Meridian	wi. and l.	wi., 15	rust	some	renew pipes
New Albany	wi.	12	rust	no	....
Winona	wi., l., ci.	......	....	no	....
Missouri:					
Butler	wi., l.	......	rust	not much	....
Hannibal	l.	......	....	....	....
Jefferson City	l., main to curb g., to house	wi., 20-40	rust	no	....
Lebanon	ci. and wi.	ci., 30; wi., 12-25	....	no	....
Liberty	s. or wi.	......	electrolysis	no	....
Macon	l. and i.	......	rust on l.	....	....
Marceline	g. wi.	6	rust	no	....
St. Louis	l. to curb	......	electrolysis	....	force pump
Trenton	l. and wi.	10-l.	rust	no	....
Webster Groves	l.	......	electrolysis	no	....
Montana:					
Anaconda	g. l. connection	10-30	rust		
Billings	l., 1½" ci., larger	g-13	g., alkali and acids	some old	renew
Glendive	l.	s. and wi.-15	chemical in soil	no	....
Great Falls	g. in past; new l.	g., 1-10	elect., chem. reaction of soil	no no	....
Missoula	g.	30+	rust, freezing	little	force pump

(For footnotes, see page 359)

Table III—Water Works Services

Municipality.	Private (P.) or munici-pal (M.) plant.	Services laid preparatory to paving, before needed for use. Are they required by city?	Kind of pipe specified.	Depth specified.	Trouble experienced with them after laying.
Alabama:					
Bessemer	P.	yes	½" g.	2 ft.	none
Gadsden	M.	yes	ll.	18 in.	none
Jasper	P.	no	none	...	....
Mobile	M.	yes	g.	at least 2 ft.	none
Montgomery	M.	yes	l.	2 ft.	none
Opelika	M.	yes	gl., ll.	2 ft.	none
Sheffield	P.	yes	l.	3 ft.	none
Talladega	M.	yes	g.	2 ft.	none
Arizona:					
Phoenix	M.	yes	...	...	breakage when rolling for pav.
Arkansas:					
Arkadelphia	M.	lay to curb when required	¾ g., stop cock and cut-off box	12 in.	corroding
Batesville	M.	no	...	18 in.	....
Ft. Smith	M.	...	...	2-2½ ft.	....
Harrison	M.	no pav.	...	2½ ft.	....
Jonesboro	M.	yes	¾" wi., g.	18 in.	none
Mena	M.	...	¾" g.	18 in.	none
Pine Bluff	P.	yes	g.	3½-4 in.	....
California:					
Long Beach	...	no	...	2 ft.	corrosion
Pasadena	M.	yes	¾" for 50 ft. lot	2 ft.	none
Pomona	P.	yes	regular	30 in.	some too small for class of consumer
Riverside	M.	no	¾" wi.	30 in.	none
San Jose	P.	no	...	18 in.	....
Santa Barbara	M.	yes	...	2 ft.	....
Santa Cruz	M.	no	...	2 ft.	....
Colorado:					
Boulder	M.	yes	wi.	3 ft.	none
Colo. Springs	M.	no	...	4 ft. 6 in.	none
Ft. Collins	M.	yes	wi.	4 ft.	none
Greeley	M.	no	l.	5 ft.	none
Longmont	M.	yes	l.	4 ft.	none
Rocky Ford	...	yes	l.	3 ft.	none
Connecticut:					
Ansonia	P.	no	...	...	....
Bridgeport	P.	no	none	4½ ft.	....
Danielson	P.	no	...	...	....
Derby	P.	request	...	4 ft. 6 in.	....
Middletown	M.	usually done	...	4½-5 ft.	....
Norwich	M.	no	...	...	....
Putnam	M.	none	...	4 ft. 9 in.	some settling
Torrington	P.	no	...	...	....
Wallingford	M.	yes	1" gwi.	4" in clay 5" in sand	none
Willimantic	M.	yes	l.	4½ ft.	none
Florida:					
Gainesville	M.	yes	l., wi.	2 ft.	leaking joint on cut-off
Jacksonville	M.	yes	g.	18-24 in.	clogging up corp. cocks
Key West	M.	...	l., flushing	12 in.	....
Lake City	M.	no	...	...	....
Live Oak	...	yes	¾" g.	3½ ft.	none
Indiana—Continued					
Elkhart	P.	yes	l.	5 ft.	freezing of services not in use
Elwood	P.	no	none	3 ft.	none
Ft. Wayne	M.	yes	...	...	....
Gas City	M.	no	¾"-2" g.; l. connec.	36 in.	they pit, cause leakage
Greenfield	M.	usually	wi.	5 ft.	none but rust
Greensburg	P.	no	none	3 ft.	....
Hobart	M.	yes	l.	5½ ft.	none
Huntington	M.	yes	⅝" l.	4 ft.	none
Indianapolis	P.	yes	l.	4½ ft.	none
Jasper	M.	no	none	...	none
Lafayette	M.	yes	l.	4½ ft.	none
La Porte	M.	yes	l.	5½ ft.	practically none
Lebanon	M.	yes	l.	3 ft.	none
Linton	M.	no	...	3 ft.	subsoil pitting
Marion	M.	no	l.	40 in.-5 ft.	elect. and wiped joints
Martinsville	...	yes	g.	42 in.	none
Mich. City	M.	no	l., wi.	4½ ft.	none
Mishawaka	M.	yes	lead	5 ft.	none
New Albany	P.	no	½" gwi.	2 ft. 6 in.	practically none
New Castle	M.	yes	reg. serv.	40 in.	none
South Bend	M.	yes	l.	5 ft.	practically none
Tell City	M.	yes	¾" gs.	4 ft.	none
Terre Haute	P.	yes	l.	4 ft. 6 in.	....
Tipton	M.	yes	g. and l.	3½-4 ft.	none
Union City	M.	no	l.	3-3½ ft.	none
Vincennes	P.	yes	½"-¾"	3 ft.	none
Whiting	M.	no	...	...	....
Iowa:					
Algona	M.	yes	l.	5½ ft.	sometimes have to lower st. to grade
Boone	M.	yes	l.	5 ft.	freezing
Burlington	P.	...	...	5 ft.	l. failed in wiped joints; also freezing
Cedar Rapids	M.	yes	l.	5½ ft.	not much
Council Bluffs	M.	yes	l.	5 ft.	practically none
Davenport	P.	yes	l.	6 ft.	breaking off due to settlement or violence
Eldora	M.	yes	double strength pipe	5 ft.	very little
Ft Dodge	M.	no	l.	5½ ft.	none
Harlan	M.	yes	i. and l.	5 ft.	very little
Independence	M.	no	l.	5½-6 ft.	clogging
Iowa Falls	M.	yes	l.	5 ft.	....
Maquoketa	M.	yes	wi., l.	5 ft.	wasting of material due to soil
Marion	P.	yes	l.	5½ ft.	none
Mason City	M.	yes	l.	6 ft.	none
Muscatine	M.	yes	l.	6 ft.	....
New Hampton	M.	yes	l.	5½ ft.	seldom any
Sac City	M.	yes	standard	5 ft.	none
Sioux City	M.	yes	l.	5½ ft.	....
Storm Lake	M.	yes	none	4 ft.	none
Valley Jct.	...	yes	g.	4 ft.	none
Washington	M.	yes	l	4½-5 ft.	none
Kansas:					
Atchison	P.	no	...	3½ ft.	....
Chanute	M.	yes	l.	2½ ft.	none
Coffeyville	M.	yes	l.	20 in. +	none
Eureka	M.	no	...	...	....

Georgia:					
Athens	M.	yes	g.	30 in.	none
Atlanta	M.	yes	wi.	2 ft.	trouble usual to wi. pipes
Bainbridge	M.	yes	...	2 ft.	none
Covington	M.	none	...	...	....
East Point	M.	yes	¾-1 in.	18 in.	none
Griffin	M.	yes	O. D. g.	2 ft.	none
La Grange	M.	yes	ll., wi.	3 ft.	none
Marietta	M.	yes	g.	2 ft	none
Moultrie	M.	yes	¾", 75' lots ½", 50' lots	18 in.	none
Pelham	M.	none	...	24 in.	....
Rome	M.	yes	1" s.	2 ft.	none
Savannah	M.	yes	...	2-6 ft.	none
Thomasville	M.	yes	gs.	...	none
Idaho:					
Boise	P.	no	...	4 ft.	....
Illinois:					
Abingdon	M.	yes	l.	4 ft.	none
Bloomington	M.	yes	l., ci.	4½ ft.	breaking at joint, leaking gasket
Bushnell	M.	no	l.	3 ft.	none
Centralia	M.	yes	l.	30 in.	none
Chicago Heights	...	some sections	l.	3 ft. 6 in.	very little
Christopher	M.	yes	l.	30 in.	none
Decatur	M.	no	g.	4 ft.	none
Depue	M.	no	...	...	....
Downers Grove	M.	yes	...	4-6 ft.	none
Effingham	P.	no	l.	3½ ft.	none
Elmhurst	M.	yes	l.	5 ft. 6 in.	none
Freeport	P.	no	...	...	....
Geneva	M.	yes	l.	5 ft.	none
Harrisburg	P.	no	l.	18-24 in.	....
Harvard	M.	yes	l.	5½ ft.	none
Harvey	P.	no	l.	4 ft. 6 in.	curb cocks get corroded
Lake Forest	M.	no	...	5½ ft.	....
Lawrenceville	P.	no	...	36 in.	none
Lincoln	P.	no	...	3¼ ft.	practically none
Mattoon	M.	yes	l.	3 ft.	none
Moline	M.	no	l.	6 ft.	none
Morrison	M.	yes	gwi.	4½-5 ft.	none
Naperville	M.	yes	l.	5 ft.	....
Peoria	P.	yes	l.	5 ft.	a few leaks
Princeton	M.	no	...	...	....
Quincy	M.	yes	l., ci.	4 ft.	none
Riverside	M.	yes	l.	5 ft.	with wiped joints
Rock Island	M.	...	l.	6 ft.	none
Rockford	M.	advocat'd	¾" single, 1" double service	6 ft.	none
St. Charles	M.	yes	l.	5 ft.	none
Springfield	M.	request	...	42 in.	none
Streator	P.	no	...	...	....
Vandalia	M.	no	...	...	....
Waukegan	M.	no	l.	5 ft.	none
W. Chicago	M.	yes	l.	4½ ft.	....
Indiana:					
Auburn	M.	yes	l.	4½ ft.	none
Aurora	P.	yes	l.	3-4 ft.	none
Bedford	M.	yes	⅝"-¾"	30 in.	none
Bluffton	M.	yes	l.	3 ft.	none
Brazil	M.	no	...	4 ft.	when not in use clog
Columbia City	M.	yes	l.	3½ ft.	none
Crawfordsville	P.	yes	¾"	4 ft.	little
Crown Point	M.	...	l.	4 ft.	settlement of trenches, careless bedding
Decatur	M.	yes	l.	3½-4 ft.	none
E. Chicago	P.	yes	l. and l.	4½ ft.	none

Fort Scott	M.	no	l.	3 ft.	....
Fredonia	M.	no	...	30 in.	....
Galena	M.	yes	g. and l.	2 ft.	none
Girard	M.	yes	l.	2 ft.	none
Great Bend	P.	no	l.	30 in.	none
Hays	M.	yes	wi. or l.	3 ft.	none
Hutchinson	P.	...	g. wi.	36 in.	elect. mostly
Independence	...	...	wi.	2½ ft.	bad weld, galvanized
Lyons	M.	yes	lead flanged union	30 in.	none in 6 yrs.
McPherson	M.	no	...	3-4 ft.	....
Olathe	M.	yes	l.	18 in.-2 ft.	none
Osawatomie	M.	no	...	30 in.	none
Pittsburg	M.	no	...	30 in.	none
Salina	P.	yes	¾" l.	3½-4 ft.	none
Topeka	M.	no	none	4 ft.	leak and stoppage
Kentucky:					
Ashland	M.	no	...	...	....
Catlettsburg	P.	no	none	no specifications	....
Covington	M.	no	⅝	3½ ft.	....
Hazard	M.	yes	¾" g.	18 in.	none
Lexington	P.	generally	l.	2½ ft.	none
Louisville	M.	yes	none	3 ft.	very little
Morganfield	M.	yes	l.	16 in.	very few
Providence	M.	yes	l.	2 ft.	none
Louisiana:					
Baton Rouge	P.	yes	l.	30 in.	very few give trouble
Kentwood	M.	no pav.	...	...	....
Leesville	P.	no	g.	18 in.	....
Rayne	M.	no	...	18-24 in.	....
Maine:					
Augusta	M.(c)	no	ll.	5½ ft.	....
Bath	M.	no	...	4½-5 ft.	....
Eastport	P.	no pav.	...	...	....
Lewiston	M.	...	...	...	....
Portland	M.	no	...	5 ft.	....
Maryland:					
Chestertown	M.	no	...	30 in.	....
Hagerstown	M.	no	none	3 ft	no
Massachusetts:					
Andover	M.	yes	ll.	5 ft.	none
Arlington	M.	yes	cl.	5 ft.	occasional frozen service
Athol	M.	no	...	5 ft.	....
Belmont	M.	no	...	...	....
Boston	M.	yes	l., ci.	5½ ft.	....
Brockton	M.	no	...	...	....
Brookline	M.	no	...	5½ ft.	....
Cambridge	M.	...	ll.	4½ ft.	....
Clinton	M.	...	...	5 ft.	....
Concord	M.	no	...	...	....
Danvers	M.	no	...	4½ ft.	....
Dedham	P.	no	...	...	....
Easthampton	M.	yes	g.	5 ft.	none
Everett	M.	...	l.	5 ft.	practically none
Fairhaven	P.	no	...	4½ ft.	none
Fitchburg	M.	no	...	6 ft.	....
Framingham	M.	yes	wi.	5 ft.	none
Haverhill	M.	no	...	...	....
Hingham	P.	...	...	...	....
Hudson	M.	yes	cl. g. wi.	6 ft.	none
Lawrence	M.	no	l.	2½-5 ft.	....
Lenox	P.	no	...	...	....
Maynard	M.	no	...	...	....
Medford	M.	no	...	...	....
Milford	P.	no	...	...	....
Montague	P.	no	...	...	....
Needham	M.	no	...	...	....

(For footnotes, see page 359)

Table III—Water Work Services—Continued

Municipality.	Private (P.) or municipal (M.) plant.	Services laid preparatory to paving, before needed for use. Are they required by city?	Kind of pipe specified.	Depth specified.	Trouble experienced with them after laying.
Massachusetts—Continued					
New Bedford	M.	in few cases	l.	4 ft.	often in wrong location for bldg. when built
Newburyport	M.	yes	wl. cl.	5 ft.	....
No. Attleboro	M.	no	...	4½ ft.	none
Norwood	M.	no	...	...	....
Oxford	M.	no	...	...	frost
Peabody	M.	yes	ll.	4½ ft.	none
Reading	M.	yes	⅝" g.	4½ ft.	none
Springfield	M.	no	...	6 ft.	usually wrong size & location for bldg.; also may leak
Swampscott	M.	yes	cl.	4-6 ft.	none
Taunton	M.	no	...	...	....
Waltham	M.	yes	1" cl.	5 ft.	none
Wareham	M.	no pav.	...	4 ft.	....
Wellesley	M.	no	...	5 ft.	none
Westboro	M.	no	none	...	....
Winthrop	M.	yes	...	5 ft.	none
Wrentham	M.	no	...	...	....
Michigan:					
Alma	M.	yes	l.	4 ft. 6 in.	none
Ann Arbor	...	yes	none	below frost line	leaks from rusting
Battle Creek	M.	yes	1"-l. more-g.	5½ ft.	very little
Bay City	M.	yes	l.	4 ft.	some frozen
Big Rapids	...	no	...	5½-6 ft.	none
Crystal Falls	M.	yes	...	6 ft.	some froze and burst
Detroit	M.	to limited extent	l. and cl.	5 ft.-paved sts; 6 unpav.	....
Dowagiac	M.	yes	l.	4 ft.	practically none
Escanaba	M.	yes	wl. g.	6 ft.	none
Gladstone	M.	yes	l.	5 ft.	none
Greenville	M.	yes	g.	5-6 ft.	none
Highland Park	M.	yes	l.	5 ft.	....
Holland	M.	yes	gs.	4 ft.	none
Ironwood	M.	no	...	...	....
Marine City	...	yes	l.	4 ft.	none
Marquette	M.	no	...	6 ft.	....
Marshall	M.	yes	s.	5 ft. 3 in.	....
Menominee	M.	yes	¾"	5 ft.	none
Mt. Clemens	M.	yes	l.	5 ft.	none
Mt. Pleasant	M.	no	...	4½ ft.	....
Niles	M.	yes	l.	5 ft.	none
Onaway	...	yes	wl. l. necks	4½ ft.	freezing only
Rochester	M.	yes	g.	4½ ft.	none
Saginaw	M.	yes	l.	5 ft.	none
St. Clair	M.	no	...	4 ft.	....
St. Louis	M.	no	none	...	....
South Haven	M.	yes	l.	4-5 ft.	freezing in some cases
Sturgis	M.	yes	⅝" l	5 ft.	none
Three Rivers	M.	yes	¾" l. with curb cocks and cut-off box	5 ft.	none
Traverse City	M.	no	...	4½ ft.	none
Wakefield	M.	yes	l.	5 ft.	none
Minnesota:					
Aurora	M.	yes	l. goose-necks; Minneapolis curb cocks	7 ft.	valve boxes raised from curb cocks by frost
Nebraska—Continued					
Gering	M.	yes	¾" pipe, stop and waste, curl cock, goose neck	5½ ft.	leakage; losing covers and filling with dirt, etc.
Hastings	M.	yes	l.	5 ft.	none
Lincoln	M.	occasionally	...	4 ft.	none
McCook	M.	yes	l.	5 ft.	none
North Platte	M.	yes	l.	3½-4 ft.	wiped joints leak
Schuyler	M.	no pav.	...	...	....
Sidney	M.	yes	l.	4 ft.	none
University Place	M.	yes	l.	4 ft. 6 in.	very little
New Hampshire:					
Berlin	P.	no	...	...	....
Claremont	...	no	...	...	....
Concord	M.	no	...	5½ ft.	....
Dover	M.	no	...	5 ft.	very little
Keene	M.	yes	brass pipe	5½ ft.	none
Lebanon	M.	no	...	...	seldom trouble if properly laid
Pembroke	M.	no pav.	...	4 ft.	....
Portsmouth	M.	no	...	4 ft.	....
New Jersey:					
Bound Brook	P.	no	...	3½-4 ft.	freeze ups occasionally
Bridgeton	M.	yes	l.	3½ ft.	none
Dunellen	P.	no	wi.	3 ft. 6 in.	none
Freehold	M.	yes	wi.	4 ft.	none
Hawthorne	M.	yes	none	4 ft.	none
Hightstown	M.	yes	¾" and 1"	3½ ft.	none
Milltown	M.	request	none	3 ft. 6 in. to 4 ft.	none
Nutley	M.	yes	same as that used	3 ft. 6 in.	....
Phillipsburg	P.	no	none	4 ft.	....
Ridgewood	M.	yes	ll. g.	4 ft.	none
Rockaway	M.	yes	⅝" corp. top, ¾" pipe	4 ft.	none
New Mexico:					
Silver City	P.	no	none	2 ft.	none
New York:					
Albany	M.	yes	l.	5 ft.	occasional stoppage
Amityville	P.	no	...	...	....
Auburn	M.	yes	¾"	4 ft.	none
Avon	M.	no	g.	4 ft.	....
Babylon	P.	yes	g.	3 ft. 6 in.	none
Baldwinsville	M.	yes	wi.	4 ft.	none
Brockport	M.	yes	wi.	3½ ft.	none
Buffalo	M.	yes	l.	5-6 ft.	small amt. of service leaks
Canastota	M.	yes	½" l.	4 ft.	breaks in wiped joints
Catskill	M.	no	...	4 ft. 6 in.	general freezing
Clyde	P.	no	...	...	....
Corning	M.	yes	...	5 ft.	....
Cortland	M.	yes	1" wi.	5 ft.	none
East Aurora	M.	yes	none	4 ft.	none
Elmira	M.	yes	l.	5½ ft.	none
Fairport	M.	yes	l.	4 ft.	none
Fort Plain	M.	yes	¾" g.	5 ft. 6 in.	bad conn. at times
Frankfort	M.	yes	l.	4½ ft.	none
Freeport	M.	no	...	...	....

Brainerd	M.	yes	g.	8 ft.	none
Cloquet	M.	no	...	7 ft.	some with frost
Crookston	P.	no	none	7½ ft.	....
Duluth	...	occasionally	l.	7½ ft.	freeze if not in use
Hastings	M.	yes	g.	7 ft.	none
Hutchinson	M.	no	...	6 ft.	....
Lake City	M.	yes	l. or g.	6½ ft.	frost if no snow
Little Falls	P.	no	...	...	....
Luverne	M.	not outside of pav. dist.	wi.	6-8 ft.	clogging
Minneapolis	M.	yes	l. with stop and box	9 ft.	due to local conditions
Northfield	M.	yes	l.	7½ ft.	none
Pipestone	M.	yes	l.	6½ ft.	lead connections
St. Cloud	...	yes	g.	7 ft.	none
St. Paul	...	yes	l., ci.	8 ft.	leaks in rare instances because of poor workmanship or defective materials
Staples	M.	acc. to judgment	g.	7½ ft.	none
Stillwater	M.	yes	wi.	7 ft.	none
Two Harbors	M.	yes	l.	5 ft.	none
Waseo	...	no	l.	5 ft.	none with lead so far
W. Minneapolis	M.	yes	l.	7 ft. 6 in.	none
Worthington	M.	yes	2" ci.	5½-6 ft.	none
Mississippi:					
Canton	M.	yes	l.	24-30 in.	none
Clarksdale	M.	yes	l.	2 ft.	none
Greenville	M.	yes	l.	15-20 in.	wiped joints
Greenwood	M.	yes	l.	30 in.	very little
Grenada	M.	yes	l.	30 in.	none
Jackson	M.	yes	l. or ci.	24 in.	none except where sts. are rolled for pav.
Laurel	M.	yes	...	to come under pav.	....
Meridian	M.	yes	l.	2 ft.	none
New Albany	...	yes	g.	30 in.	none
Winona	M.	yes	l.	12 in.	none
Missouri:					
Butler	M.	...	...	...	....
Hannibal	M.	no	...	4 ft.	....
Jefferson City	P.	no	...	3 ft. 6 in.	only where faulty workmanship
Lebanon	M.	no	...	2 ft.	frost; breaks from rust in small wi. pipes
Liberty	M.	yes	...	2½ ft.	....
Macon	M.	no	...	...	....
Marceline	M.	no	...	3 ft.	....
St. Louis	M.	no	...	...	....
Trenton	M.	yes	l.	below freezing point	locating
Webster Groves	both (g)	no	...	...	....
Montana:					
Anaconda	P.	yes	g, l. connection	6 ft.	none
Billings	M.	yes	l. and ci.	5½ ft.	none
Glendive	M.	expect to	l.	6½ ft.	none
Great Falls	M.	yes	l.	5 ft.	....
Missoula	P.	no	...	6 ft.	....
Nebraska:					
Aurora	M.	no	¾" g. or l.	5 ft.	freezing when sts. graded; giving out
Chadron	M.	yes	l.	4 ft.	none
Fairbury	M.	yes	3½ l.	5 ft.	none
Fremont	M.	yes	...	4½ ft.	....
Geneva	M.	yes	l.	4 ft.	none
Glen Falls	M.	yes	¾", ½" con.	4-6 ft.	none
Gloversville	M.	yes	l.	4½-6 ft.	freezing and bursting. Corrosion at corp. cock if not used
Hamburg	P.	no	...	4-4½ ft.	none
Hoosick Falls	...	...	g.	...	....
Hudson	M.	yes	l.	5 ft.	sometimes freezing
Hudson Falls	P.	yes	...	5 ft.	none
Ithaca	M.	yes	l.	5 ft.	....
Jamestown	M.	yes	wi.	4 ft. 6 in.	shorter life than active service
Le Roy	M.	no	wi.	5 ft.	....
Lyons	M.	no	...	4½ ft.	few affected by frost
Middletown	M.	yes	...	4½ ft.	....
Mohawk	M.	yes	g.	4 ft.	none
Mount Morris	M.	no	brass or l.	4 ft.	none
Mount Vernon	P.	no	l.	3½ ft.	none
Newark	M.	yes	l.	4½ ft.	none
New York	M.	no	...	...	....
Norwich	P.	yes	...	5 ft.	none
Nyack	M.	yes	¾"-1" g.	3½-4 ft.	rust holes
Ogdensburg	M.	yes	g. wi.	5 ft. 6 in.	none
Olean	M.	yes	l.	3½-4 ft.	none
Oneonta	P.	yes	l.	5 ft.	occasional leak
Ossining	M.	no	l.	4½ ft.	had to dig up at main and curb
Oswego	M.	yes	l.	4 ft.	none
Perry	M.	yes	g. wi.	4 ft.	none
Rochester	M.	yes	l., ll.	4½ ft.	....
Salamanca	M.	no	...	4 ft.	....
Saratoga Sprgs.	M.	yes	g.	below frost zone	mostly from service lines laid before corp. cocks were used
Scotia	M.	yes	⅝" l.	5 ft.	none
Seneca Falls	P.	yes	g.	4½ ft.	giving out of wiped joints on gooseneck
Sidney	M.	yes	l.	5 ft.	freezing, cracking of joints
Syracuse	M.	yes	l.	5 ft.	more or less frozen services
Tarrytown	M.	in some cases	l.	3 ft. 6 in.	none
Wappingers Falls	M.	yes	l.	4 ft.	none
Waterford	M.	yes	none	5 ft.	rust
Waterloo	P.	yes	wi.	4 ft.	elect. only
Watertown	M.	yes	g. wi.	5 ft.	none
Watervliet	M.	yes	l.	5 ft.	none
Wellsville	M.	generally	wi. g.	5 ft.	none
Westfield	M.	no	...	4½ ft.	elect.
Yonkers	M.	no	...	4 ft.	very little
North Carolina:					
Canton	M.	yes	g. l. goosenecks	4 ft.	none
Greensboro	M.	yes	wi.	18 in.	....
High Point	M.	yes	water tap without meter	2 ft.	....
Lenoir	M.	yes	none	2 ft.	none
Monroe	M.	yes	wi. l. goosenecks	2 ft.	scarcely any
Morehead City	M.	no	...	...	....

(a) Ten years in clay and hardpan, 20 years in sandy loam; (b) g. until 1 year ago, now heavy lead for all services in street to curb box, when galv pipe may be used; (c) quasi municipal; (d) ll. to street line where road is macadam; (e) principally lead, now introducing ci.; (f) lead main to near curb, up to 1"; 2" g., 4" up ci. curb to house ¾" to 2" g.; (g) municipal distribution system—private supply; (h) lead pipe across streets and alleys; galv. iron, lot line into building; (j) company owns mains only. Services financed and maintained by property owners.

Recent Legal Decisions

IMPROVEMENT HELD TO DIFFER FROM THAT AUTHORIZED BY ORDINANCE SO THAT ASSESSMENT COULD NOT BE LEVIED.

The authority to make local improvements by special assessment is statutory, and the statute must be followed strictly in order to give the courts jurisdiction to enforce the collection of the assessments. The Illinois Supreme Court holds, City of Chicago v. Jerome, 134 N. E. 92, that a legal and sufficient ordinance lies at the foundation of every valid assessment. Such ordinance must prescribe the nature, character, locality and description of the improvement to be made. If the improvement constructed is substantially different from the improvement authorized to be constructed by the ordinance, property owners cannot be compelled to pay for it by special assessment. Where five lateral sewers, designed to serve a subdivision consisting of 80 acres of land, had been abandoned, this was held to be an entirely different improvement from that described in the original ordinance, and the only way in which that ordinance could be amended was by passing another valid ordinance.

PROPERTY SUBJECT TO PAVING ASSESSMENT HELD NOT RELIEVED SO AS TO MAKE MUNICIPALITY LIABLE.

It is well settled that where a city, after letting a contract for a public improvement to be paid for by assessments on private property to which such property is liable, and after a large part of the expense of making it has been incurred by the contractor, does any acts without the consent of the contractor to release from liability part of the property subject to assessment, and thereby make it impossible for the contractor to collect part of the contract price for his work, the city will be liable to him for the amount thus made uncollectable. But the Indiana Supreme Court holds, City of LaPorte v. Ahlborn, 133 N. E. 874, that when a contract to fill, grade and pave a street was nearly done and after the contract time for completion, a city passed an ordinance requiring a street railway company to locate its tracks along the centre of the street, which ordinance was subsequently repealed, this did not make the city liable for part of the cost of the improvement, on the ground of having relieved the company from the liability.

PROCEDURE IN REFERENDUM FOR PURCHASE OF PUBLIC UTILITY PLANT.

Where a statute authorizes a municipality to require a referendum vote on the question whether it shall acquire, within or without the municipality, a plant for the manufacture of gas, electricity or steam for supplying light, heat and power, or two or all of these, and that the municipality may by resolution require such a referendum, according to which the ballots must be prepared, the resolution must definitely state the character of the plant necessary, and clearly indicate the purpose of the referendum, so that a distinct proposition is presented on which the voter may vote "Yes" or "No." Whether the plant shall be within or without the city, or whether the lighting shall be by gas or electricity, are, under the statute, distinct propositions, on each of which the voter must be given an opportunity to answer "Yes" or "No."—Board of Trade of City of Newark v. City of Newark, New Jersey Supreme Court, 116 Atl. 172.

FIXTURES OF MUNICIPAL PLANT EXEMPT FROM TAXATION.

The Maine Supreme Judicial Court holds, Inhabitants of Whiting v. Inhabitants of Lubec, 115 Atl. 896, that under Maine Laws 1911, c. 120, exempting fixtures used by municipal corporations in supplying water, power, or light, a penstock, or large pipe, through which water runs from the dam to the power house, an electric generator, and other machinery, as well as the transmission lines, are fixtures, and as such exempt from taxation.

SALE OF PUBLIC WORKS BONDS TO CONTRACTORS CONTINGENT ON AWARD OF CONTRACT TO THEM IF LOWEST HELD VALID.

The Texas Court of Civil Appeals holds, Gibson v. Davis, 236 S. W. 202, that the fact that a bid for the purchase of road bonds is contingent upon the award to the bidder of the contract to construct the proposed road is no legal obstacle to the consummation of the sale of the bonds to the bidder, where it is shown that his bid was a sum above the market value of the bonds, and that his bid for the construction of the road was the lowest and best bid obtainable, and not above the sums usually prevailing for such work. In Ogg v. Dies, 176 S. W. 638, a similar case, the court said: "The law does not prohibit a county from selling bonds to contractors for public works for the construction of which the bonds are issued. The (Texas) statute forbids the sale of bonds of this character for less than par value and accrued interest."

EXPEDIENCY OF WATERWORKS AND SEWER IMPROVEMENTS FOR CITY COUNCIL.

In an action by certain taxpayers of the city of Hankinson to enjoin its officers from proceeding further with the construction of certain waterworks and sewer systems, the North Dakota Supreme Court holds, Jones v. City of Hankinson, 186 N. W. 276, that the evidence did not establish fraud of the officers, or the condition alleged, that "usually the engineer has some friend contractor with whom he is dealing, or in whose business he has a direct interest," which prevents him safeguarding the interests of the city. The court said: "It is said that the improvements are too expensive, and are of doubtful value. These, of course, are administrative or legislative, and not judicial, questions. There are few, if any, municipal improvements constructed but that some one questions the necessity or reasonableness thereof. The power to determine these questions is conferred upon the city council. The court may inquire into the acts of the council to ascertain whether they have acted according to law, but the court may not substitute its judgment for the judgment of the city as to the wisdom or expediency of the improvement."

NEWS OF THE SOCIETIES

CALENDAR

May 15-16—FLORIDA ENGINEERING SOCIETY. Daytona, Fla.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19 — NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18 — CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

May 17—UTAH SOCIETY OF ENGINEERS. University Club, Salt Lake City.

May 17-18—LEAGUE OF TEXAS MUNICIPALITIES. Annual convention. Waxahachie, Tex. Secretary, F. M. Stewart, University of Texas, Austin.

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE, Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary Edgar E. Harlan, Des Moines, Iowa.

June 5-7—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 5-7—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference. Springfield, Mass. Secretary, F. Shurtleff. 60 State St., Boston, Mass.

June 6-8—CONFERENCE OF NEW YORK STATE MAYORS AND OTHER CITY OFFICIALS. Annual meeting. Poughkeepsie, N. Y. Secretary, W. P. Capes, 25 Washington Ave., Albany, N. Y.

June 7 — NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16 — CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1 — AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 1-6—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

LOUISIANA ENGINEERING SOCIETY.

The regular meeting in New Orleans was held Monday, May 8. A paper entitled "The Limitation of Loads on Highways," was presented by Donald A. DuPlantier. It was resolved by the Louisiana Engineering Society that it approves and endorses the construction of the New Orleans-Hammond Lake Shore Highway, and that it urges the State Highway Commission and all other interested authorities to hasten the financing of the remainder of the estimate cost and proceed with the construction.

NEW YORK STATE CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS.

New York State City Clerks' Association—New York State Fire Chiefs' Association—With Sectional Meetings for Purchasing Agents, Corporation Counsels and City Attorneys, Charity Officials, Assessors, City Engineers, Health Officers, and Comptrollers, City Treasurers and City Chamberlains.

The conference and association headquarters will be at the Nelson House, Poughkeepsie, June 7-8.

June 5—8:00 p. m., joint meeting of officers, advisory committee and bureau council of the conference, headquarters, Nelson House.

June 6—Inspection of bureau exhibit.

Joint session of conference and associations. "The Year's Progress in Municipal Work in New York State," (president's annual address), Hon. William J. Wallin; "Results of the Legislative Work by the Cities," Hon. William S. Hackett; "Increasing Administrative Efficiency," Bureau Council report; "Solving the Cities' Pension Problem," F. B. Holmes; "The Milk Problem in New York State Cities," Dr. Matthias Nichol; "Investigating a City's Increase in Taxation," Hon. Thomas A. Wilson.

Joint session of conference and associations, 7:00 p. m.—"Progress in the Municipal Home Rule Movement," Senator Ward V. Tolbert; "Equalizing the Burden of Taxation," Senator Frederick M. Davenport; "The State and Its Municipalities,' 'Governor Nathan L. Miller.

June 7—Symposium: "What Progress Has Your City Administration Made During the Last Year?"; "What Municipal Problems Is Your City Now Endeavoring to Solve?" (The roll of cities will be called and the representative of each will answer the above questions.) "The Automobile Traffic Problem," Robbins B. Stoeckel; "Mt. Vernon's Model Charter," Hon. Edwin W. Fiske; "The Education Problem in New York State Cities."

Joint session of conference and associations, 8:00 p. m.—"How to Solve the Problem of Reforesting Municipal Water Sheds and Parks at the Least Expense," J. R. Simmons; "Results of the Co-operative Work by New Jersey Municipalities," Hon. Charles P. Gillen; "The Human Side of Municipal Government," John F. Hylan.

Joint session of conference and associations, 9:30 a. m.—A summary of the discussions and business transacted at each sectional meeting held on the two previous days will be given in the following order: City engineers, city clerks, corporation counsels, charity officials, assessors, fire chiefs, fiscal officers, health officers, purchasing agents.

Sectional meeting for corporation counsels and city attorneys, June 6—"Service Charge Legislation, Charles A. Van Auken; "The Legal Side of the Proposed Repeal of the State Railway Paving Law," William S. Elder; "Drafting City Ordinances," Ernest Cawcroft; "Court Decisions Affecting Rate Proceedings," John P. O'Brien.

Sectional meeting for city engineers, June 7—"Trolley Tracks in Street Pavements," A. P. Hartmann; "Modern Street Lighting Practice" (illustrated), A. F. Dickerson; "Distinctive Features of Warrenite-Bitulithic Pavements in Comparison with Other Bituminous Pavements, (illustrated) Geo. C. Warren.

Sectional meeting for municipal fiscal officers (comptrollers, city treasurers and city chamberlains), June 7—"Rochester's System of Financing Public Improvements," Joseph C. Wilson; "Methods of Paying Coupon Bonds and Interest," William A. Toohey; "Methods of Control of Revenues from Water Rentals," J. Walter Ackerman; "Defects Revealed by State Examinations," Charles R. Hall.

Sectional meeting for city purchasing agents, June 6—"The Contribution of the Purchasing Agent to Economical Administration," "The Human Element in Centralized Municipal Purchasing and the Personal Qualifications of the Purchasing Agent," "Standardization of Supplies and Procedure," "The Modern Stores Department and the Central Storehouse," "Purchasing in the Open Market vs. Purchasing in the Home City," "Cash Discounts," "Confirmatory Orders," "The Purchasing Agent of Tomorrow," "Purchasing from State Prison Department," "Group Purchasing."

AMERICAN CONSTRUCTION COUNCIL.

Preliminary arrangements were completed in Washington, D. C., May 3, for the organization of the American Construction Council. Secretary of Commerce Hoover will be the chairman of the organization meeting to be held in Pittsburgh, June 19, and Franklin D. Roosevelt, formerly Assistant Secretary of the Navy, will be the president of the organization.

The purpose of the Council is to place the construction industry on a high plane of integrity and efficiency and to correlate the efforts toward betterment made by the existing organizations, through a conference association representative of the whole industry and dedicated to the improvement of the service which the construction industry renders to communities, states, and nation.

All branches of the industry are represented in the new body and have been divided into the following groups, each with equal voting power: Architects, engineers, general contractors, sub-contractors, construction labor, material and equipment manufacturers, material and equipment dealers, financial, bond and

real estate interests, public utility construction departments, and the construction divisions of federal, state and municipal governments.

The organizers of the Council are planning to take up a code of ethics for the industry, development of a national building code; a research and statistical bureau; lengthening of the construction season; elimination of waste; standardization and dimensional simplification; development of apprenticeship systems; and encouragement of local study and better understanding of building situations.

AMERICAN RAILWAY ENGINEERING ASSOCIATION

At its recent annual convention the American Railway Engineering Association elected the following officers: President, James L. Campbell; vice-presidents, E. H. Lee and G. J. Ray; directors, D. J. Brumley, Maurice Coburn, H. T. Douglas, Jr., C. E. Lindsay and W. P. Wiltsee; treasurer, G. H. Bremmer; secretary, E. H. Fritch.

ONTARIO GOOD ROADS ASSOCIATION

The Ontario Good Roads Association elected the following officers at its recent annual convention at Toronto: President, W. H. Brown; vice-presidents, John Curry and George S. Henry; and directors, F. A. Senecal, J. E. Jamieson, A. B. Rose, Peter Ray, F. H. Richardson, and W. H. Nugent.

ROCHESTER ENGINEERING SOCIETY

At the April 11 meeting of the Rochester Engineering Society, held at the Powers Hotel, Mr. L. B. Roberts, division engineer, New York Water Power Investigation, gave an illustrated talk on "Maps and Mapping." The subject was well presented, due to the experience of the speaker in topographic mapping with the United States Geological Survey, and the talk was an exceedingly interesting one.

SOCIETY OF INDUSTRIAL ENGINEERS

The national spring convention will be held at the Hotel Statler, Detroit, on April 26-28. There will be addresses on "The Influence of Industrial Engineering Upon the Earnings of Capital and Labor," including how industrial engineering serves (a) industry, (b) the chief, (c) the executive, (d) the sales manager and (e) the factory manager; also its service to (a) labor, (b) finance and (c) the public. There will also be papers and discussions on "The Conservation of Material, of Plant and Equipment and of Labor and the Workman."

INTERNATIONAL ASSOCIATION OF RAILWAYS

The International Association of Railways will hold its Ninth Congress in Rome, Italy, from April 18th to 30th. The Federated American Engineering Societies was asked to secure the appointment of Mr. J. W. Lieb, former president of the American Institute of Electrical Engineers, former vice-president of the American Society of Mechanical Engineers, and during the war, chairman of the Joint Committee on Power and Gas Industries, Council of National Defense. Mr. Lieb will represent the United States, together with Mr. Charles C. McChord, of the Interstate Commerce Commission, General William W. Atterbury, Col. Edward A. Simmons, Mr. David F. Crawford and Mr. Walter F. Schleiter.

PERSONALS

Rhodes, William H., Jr., has accepted the position of maintenance engineer with the Louisiana Highway Commission.

North, Thomas C., borough engineer of DuBois, Pa., has been elected borough engineer and manager of Blairsville, Pa.

Young, D. A., has recently been appointed state engineer of Vermont.

Sheddan, W. E., formerly assistant city engineer of Jacksonville, Fla., has been appointed city engineer to succeed F. M. Edwards, resigned.

Smith, Alva, for fifteen years city engineer of Emporia, Kan., has resigned.

Layle, John W., superintendent of highways at Bridgeburg, Ont., has resigned to accept a similar position at Fort Erie, Ont.

Knight, D. H., of Kokomo, Ind., will succeed William R. Payne, resigned, as city engineer of Frankfort, Ind.

Fregolie, Walfred, has been appointed village engineer of Hibbing, Minn.

Stanley, George C., has been reappointed city engineer of Burlington, Vt.

Kennedy, J. H., has been reappointed superintendent of waterworks of St. Albans, Vt.

Grimes, L. A., has been appointed superintendent of waterworks and sewers of Abilene, Tex.

Fulenwiter, Henry A., of Wilmington, Del., has been appointed town engineer of New Castle, Del.

Lang, Capt. Fred W., assistant city engineer of Concord, N. H., has been appointed city engineer to succeed W. B. Howe, who died April 3.

Hawkins, H. E., city engineer of Eldorado, Kan., has been appointed city manager.

Hummel, R. S., has been appointed chief of the recently established bureau of street paving of the department of public works, Richmond, Va.

Anderson, Benton, has been elected city engineer of Clinton, Ia.

Goebel, Norman J., engineer for the board of water commissioners, Oshawa, Ont., has resigned.

Bodette, George H., formerly city engineer of Toledo, Ohio, died on April 11 at his home, at the age of 70.

HYDRO-ELECTRIC POWER PROJECTS DISCUSSED BY CABINET

The Boston to Washington superpower survey, the Colorado River development and other projects were discussed by President Harding and his cabinet on April 8th, as a means of minimizing the effect of coal strikes in the future and also in relation to the general economic fabric of the country. According to reports the discussion was most thorough, although no definite conclusions were reached. Secretary Hoover submitted the proposition for discussion and it is said that the cabinet intends to continue its study of the project. The superpower survey of the Atlantic seaboard was fostered by the Engineering Council and a very complete report was prepared for Congress by a commission of engineers about a year ago.

EXAMPLES OF NOTABLE ANCIENT AND MODERN CONSTRUCTION.

Comparative examples of notable ancient and modern construction embodying elements of permanency provided for by the use of concrete.

A Notably handsome and artistic booklet, 31 pages, printed on rich heavy paper and illustrated with a large number of half page and full page colored engravings and sumptuously bound in heavy, rich paper covers, text by Philip Koehring, illustrations by William Mark Young, copyrighted, published and distributed by the Koehring Co. The dominant note is the endurance of human achievement with special reference to the part played by concrete in great public structures for two thousand years and showing the wide field and vast opportunities of the modern scientific and mechanical improvement in concrete work.

Interesting and practical outlines illustrated by artistic etchings are given of many diverse ancient and modern structures, including the Aecropolis at Athens, the Bush Terminal in Brooklyn, the Colosseum at Rome, New York Baseball Stadium, Nimes Roman Viaduct and Highways, Tunkhannock Viaduct, Pennsylvania, great arch bridges, Pyramid of Cheops, Black Hawk Monument, and American highways, dams, sewers and buildings and the Koehring Machinery Plant.

AVERAGE COST OF DIFFERENT PAVEMENTS

A recent compilation by the U. S. Bureau of Records, on the cost of various types of road pavement, covers 68 million square yards of paving constructed with Federal aid in all parts of the United States from 1916 to 1921. The following square yard costs of paving are average figures only: Sand-clay, 18c; gravel, 46c; plain and surface-treated macadam, 95c; bituminous macadam, \$2.10; bituminous concrete, \$2.50; plain cement concrete, \$2.57; reinforced cement concrete, \$2.74; and brick, \$4.10.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

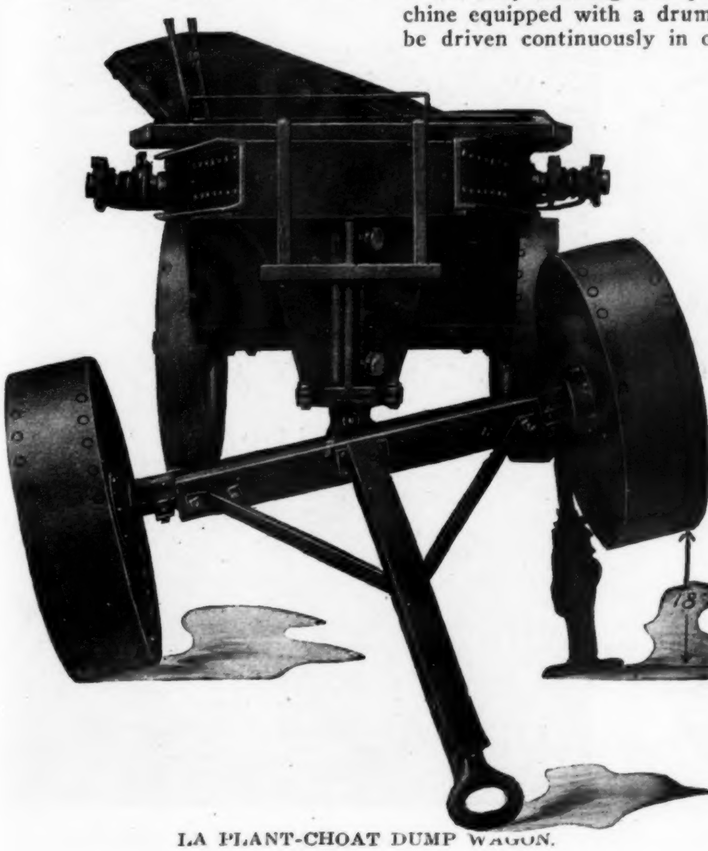
SIX-YARD DUMP WAGON HAULED BY 5-TON TRACTOR.

LA PLANT-CHOAT DUMP WAGONS

The dump wagons produced by the La Plant-Choat Mfg. Co. are made entirely of steel with a special extra strong design intended for service with a tractor and for long endurance under difficult conditions with few or no repairs. Their six-yard capacity makes them suitable for use singly and in pairs with five-ton and ten-ton tractors respectively.

The body and dumping doors are made of reinforced 3/16-inch boiler plate, the main frame is of 8-inch channels not riveted, and the tongue is a 4-inch braced I-beam. The disc wheels are unbreakable and are mounted on roller bearings, lubricated by a grease gun. The front axle has a pivot bearing and the wheels have very wide treads fitting them to carry heavy loads on soft ground. The frame is strong enough to endure the full pull of the 10-h.p. tractor without injury.

One purchaser states that a 5-ton tractor hitched with one 6-yard dump wagon handled an average of 250 yards per day on 500 to 700-foot hauls, with no repair bill and no time lost for wagon breakdowns.



LA PLANT-CHOAT DUMP WAGON.

PORTABLE POWER PLANT

The Pullco Pulling Jack, made by the Puller Manufacturing Company, is an all-steel hand-power machine, combining the principles of both jack and winch, in which pawl and ratchet mechanism is utilized to wind cable on a drum for hoisting and pulling. It is the only hoisting and pulling machine equipped with a drum that can be driven continuously in one direction at high and low speed by a lever moving pendulum fashion.

The Pulling Jack is provided with levers 4½ and 5½ feet long, which drive the drum regardless of the direction of the lever movement, and also with cranks for use when it is desirable to operate the machine as an ordinary winch.

The 5½-foot lever, it is claimed, enables the operator to apply nearly four times the leverage of the crank to the same load. It is possible for one man, using the lever, to hoist five hundred pounds at the rate of 25 feet per minute, and five tons 3½ feet a minute. Direct pull of fifteen tons on a single cable was registered on a testing machine with two men using the 5½-foot lever and exerting their maximum strength. Additional power can be developed by the use of tackle blocks.

PULLCO JACK WINCH
WEIGHT 195 LBS. CAPACITY 50 TONS

The machine weighs 195 pounds is 32 inches long, 18 inches high and 18 inches wide; being mounted on wheels is easily moved from place to place, or can be carried bodily by two men. It is fitted with a hand brake, cable brake and reverse mechanism. Other equipment consists of all-steel cables, tackle blocks, take-up and anchor hook.

The Pulling Jack is recommended for use in pipe laying, pulling test boring pipe, well casing and tubing, cleaning pipe lines, moving machinery, setting and moving boilers, erecting stacks, tanks and windmills, tightening guy lines, erecting aerial tramways, spotting railroad cars, re-railing derailed cars, clearing wreckage, felling walls, bridge building, tunnel construction, unloading freight, moving hoists, concrete mixers, steam shovels,

drilling machines, setting up derricks, binding pile clusters, stay lathing, setting brace piles, pulling sheet piles, moving barges against wind and tide, springing heavy planking in position in barge building, pulling trucks out of the mire, felling trees, pulling stumps and for emergency hoisting and miscellaneous operations.

RUSSELL DRAGLINE

The dragline machine, made by the Russell Grader Mfg. Co., is designed to excavate sand and gravel and convey it from 150 feet to 400 feet to a loading plant at a low cost. It is made in 3 sizes equipped with 45, 30 or 15-h. p. gasoline engine handling ¾, ½ or ⅓ yard buckets and having a capacity of 450, 350 or 250 yards per day, respectively. It is self-filling, self-dumping; can be operated by one man to do the work of several teams; and is recommended for stripping pits, dragging material uphill or downhill, or taking gravel out of creek bed. The operating engine has a front drum for the load cable and a rear drum for the return cable, which passes through a guide block anchored to a dead man. The drums are fitted with tension clutches which are reversed to operate the buckets back and forth. The engines are normally run at 300 to 600 rpm with excavating speeds of buckets at 140, 190, 175 feet per minute and for taking the empty bucket out at 280, 350 and 320 feet per minute for the small, intermediate, and large sizes, respectively.

The bottomless buckets load and unload without the use of manual labor and are automatically dumped by putting the return cable into operation. The engine and drums are mounted on a steel truck and the total weight is 4,600 pounds for the small, 7,075 pounds for the medium and 7,750 pounds for the large machine.

INDUSTRIAL NOTES

Wunsch & TerKuile, Brooklyn, N. Y., is a new firm organized by J. W. Wunsch and C. V. TerKuile, for the sale of materials, handling machinery and industrial and engineering equipment.

William Cramp & Sons Ship & Engine Building Co. have acquired the plant and interests of the Pelton Water Wheel Co., of San Francisco and New York, which will retain its old corporate name and policy.

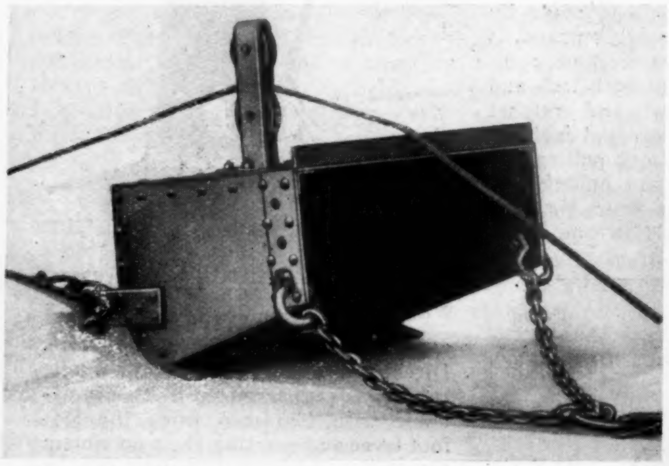
Benham, Webster L., under the firm name of Benham Engineering Co., Consulting Engineers, Suite 512, Gumbel Building, Kansas City, Mo., has taken over all contracts of Benham & Mullergren, and will continue to act as Consulting Engineers on waterworks, sewers and sewage disposal, electric light and power plants, street paving and valuations.

Mullergren, A. L., retires from the Benham Engineering Company, and will engage in private practice, specializing in electric light and power plant engineering and public utilities, Gates Building, Kansas City, Mo.

CONSOLIDATION ANNOUNCED

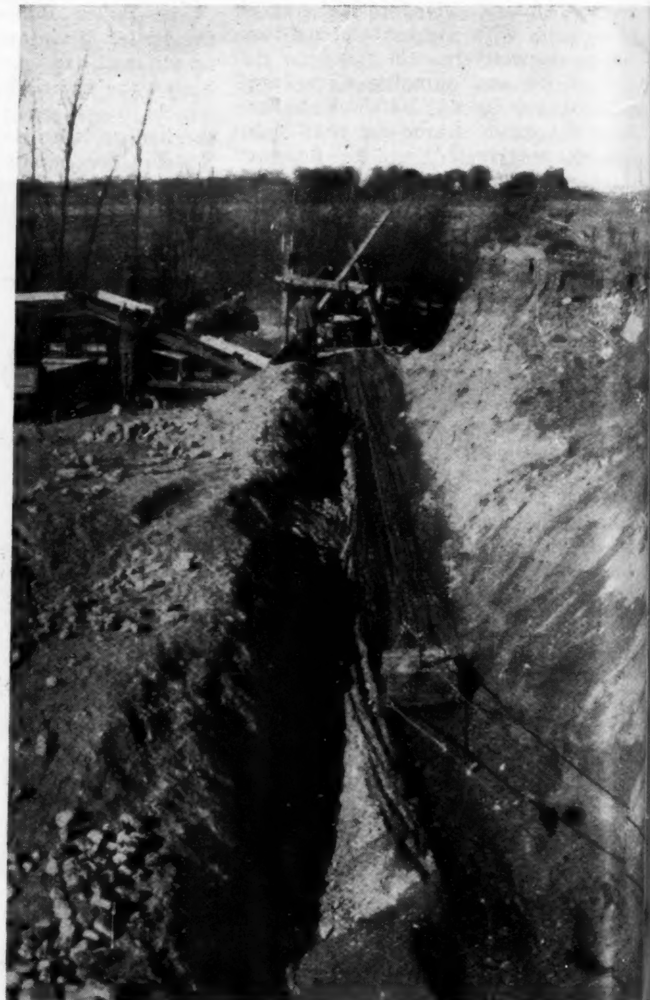
The consolidation is announced of the engineering firms of W. R. Heagler & Sons, of Paragould, Ark., and Hiram Phillips, of St. Louis, Missouri.

Drainage, flood protection, irrigation, power development, sewerage, water supply, reports, estimates and appraisals. Business will be continued under the firm name of Hiram Phillips Engineering Co., Fullerton Building, St. Louis, Missouri, and in Paragould, Arkansas.



RUSSELL 1/3 TO 3/4 YARD DRAG LINE BUCKET.

RUSSELL DRAG LINE MOUNTED ON TRUCK.



RUSSELL DRAG LINE IN SERVICE.